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MEMOIRS
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AMERICAN ENTOMOLOGICAL SOCIETY
NUMBER 28

TISCHERIIDAE OF AMERICA NORTH OF MEXICO (MICROLEPIDOPTERA)

BY

ANNETTE F. BRAUN

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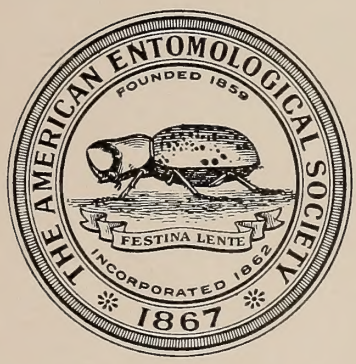

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SELWYN S. ROBACK
EDITOR

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Cincinnati, Ohio

INTRODUCTION

The family Tischeriidae includes only one genus, *Tischeria* Zeller. The genus *Coptotriche* erected by Walsingham (1890) for *zelleriella* Clemens (syn. *complanoides* Frey & Boll, *latipennella* Chambers) on the basis of characters of the hind wing of the male is not separable from *Tischeria*. Genitalic characters agree in all respects with typical members of other Quercus-mining species. The hind wing of the male is approached in breadth and specialization of cilia by the hind wing of the male of *Tischeria sulphurea* Frey & Boll. The retention of the frass within the mine, in contrast with its ejection, occurs in several species not otherwise differing from typical *Tischeria* in adult characters.

Although the several groups of the genus differ widely in color of wings, presence or absence of wing markings, species of the genus can usually be recognized easily by general aspect. The head with rough or flattened tuft, smooth face, short drooping labial palpi, and the broad antennal scape, with projecting scales afford immediate recognition.

Mines, though variable in appearance within the genus, are often characteristic of the species, and may offer the best diagnostic characters, exclusive of genitalic characters, which in some instances, must be relied on for positive identification.

The genus is of particular interest because of the presence of some unique characters in the female genitalia.

Tischeria includes about 65 species and is best represented in America, with 48 species now recognized north of Mexico. A few additional species have been recorded from Mexico, the West Indies, and South America. Ten or more occur in Europe; several in India and South Africa.

In the present treatment, a total of 49 species are included in the genus. Of the 31 species listed in McDunnough's Checklist of the Lepidoptera of Canada and the United States of America, Part II, Microlepidoptera (1939), *cinerotunicella* Braun, *nubila* Braun, *albostraminea* Walsingham, and *tinctoriella* Chambers are reduced to synonymy, and *purinosella* Chambers (syn. *albostraminea*) is reinstated. *Tischeria elongata* Walsingham, described from Mexico, is included because of its close relationship to *T. quercitella* Clemens, indicated by the similar genitalia. Twenty species are described as new.

Examples of the imagoes of all species except *Tischeria heteroterae* F. & B., *T. longe-ciliata* F. & B., and *T. elongata* Wlsm., the types of which are in the British Museum, have been examined. Of these, the type of *T. longe-ciliata* lacks abdomen. Slides of the female genitalia of the type of *T. heteroterae,* and of the male genitalia of the type of *T. elongata* were prepared by Dr. Don R. Davis; the figures were drawn by an artist at the United States National Museum. With these exceptions, all figures were drawn by the writer. Photographs of the types of *T. heteroterae* and *T. elongata* have been examined; figure 4, the wings of *T. heteroterae,* was drawn by the writer from the photograph.

The figures of genitalia, larvae, pupae, and venation were drawn with the use of a binocular microscope equipped with an ocular grid. For addition of the finer details on the genitalia drawings, the higher power of a compound microscope was necessary. In most instances, the bursa copulatrix and most of the ductus bursae have been omitted;

the microscopic spinulose character of these organs could not have been delineated without undue increase in the size of the drawings.

Over 2000 specimens have been examined in the preparation of this monograph; over 700 in my own collection, most of them reared, and including types, allotypes or paratypes of 9 new species; over 400 in the United States National Museum, including types, allotypes or paratypes of 7 new species; about 175 specimens of imagoes, and over 50 examples of mined leaves in the Canadian National Collection, with paratypes of one new species; about 200 specimens in the Darlington Collection, Academy of Natural Sciences of Philadelphia, with type, allotype, and paratypes of one new species; 500 specimens from the University of California collections, most of them reared and accompanied by a large number of well-preserved mines, including types, allotypes or paratypes of seven new species. Some additional material from C. P. Kimball has been examined. The material from the University of California (reared by Dr. Jerry A. Powell and Paul A. Opler) merits special note. This has added greatly to our knowledge of the Tischeriid fauna of California and Arizona.

To Dr. J. F. Gates Clarke and to Dr. Donald R. Davis, thanks are due for various courtesies extended, acknowledged in appropriate positions in the text.

Abbreviations used in the text referring to the location of material are as follows: [AFB] (Collection of Annette F. Braun); [USNM] (United States National Museum); [ANSP] (Darlington Collection, Academy of Natural Sciences of Philadelphia); [CNC] (Canadian National Collection); [UCB] (University of California at Berkeley); [MCZ] (Museum of Comparative Zoology); [BM] (British Museum).

Genus TISCHERIA Zeller

Tischeria Zeller, 1839. Isis, XXXII, 219. Genotype, *complanella* Hübner (=*ekebladella* Bjk.).

Evexia (Emend. pro *Tischeria* Zeller 1839) Gistl [1847], Handb. Natunges., 1850, 486; 1848, Nat. Thierr., 148.

Philodoxa (Emend. pro *Tischeria* 1839) Gistl 1848, Nat. Thierr., XI.

Coptotriche Walsingham, 1890. Insect Life, II, 322.

Tisheria Busck, 1903. Proc. Ent. Soc. Wash., V, 190, 191, 212, 214 (misspelling).

Imagoes

Small to very small, with wing expanse from 6 to 11 mm; hind wings with long cilia; fore wings may be yellow, more or less orange-shaded, with few markings, dark gray, blackish or bronzy, or pale whitish or yellowish, with bands or groups of dark-tipped scales.

Crown rough-tufted, with scales spreading (fig. 2), or tuft with scales little spreading (fig. 1), or tuft smooth, flattened and projecting over face (fig. 3); face smooth, tapering; maxillary palpi minute, rudimentary; tongue scaled near base; labial palpi short to very short, pointed, scales projecting at apex, in one group (the miners on Compositae) with two strong spine-like setae arising on the lower side of the basal segment (fig. 2). Antennae nearly as long as the fore wings, scape broad, scaled, the scales projecting as a modified pecten; shaft slender, in males with long fine cilia beneath, shaft typically smooth in females, or (in Composite feeders) from long ciliate to microscopically ciliate, or (in some Rosaceous feeders) with cilia $\frac{1}{2}$ to $\frac{3}{4}$ the length of cilia of male, or (in Malvaceous feeders) very short, but evident.

Fore wings lanceolate, R_1 arising before middle, R_3 sometimes absent, R_5 to costa, R_4 and R_5 rarely coincident, radial cell defined; base of M discernible, M_1 and M_2 coincident, M_{1+2} sometimes stalked with R_5 or rarely approximate or connate or stalked with M_3; M_3 distant from Cu; Cu unbranched and running directly to the inner margin or bending abruptly at end of cell, thence as a short spur to inner margin: 2A simple. Hind wings narrow-acuminate, less than half the width of the fore wings to broad or broader than the fore wings, and more or less abruptly tapering to the acute apex, long ciliate; radial sector distinct to near apex, M_1 and M_2 usually coincident, occasionally M_2 faintly indicated near wing margin, M_3 absent, cell open, Cu unbranched; two anal veins present. Female frenulum of two closely appressed bristles. (Plate I, figs. 5, 6, 6a and Plate II.)

Both fore and hind wings partially aculeate; in the fore wing the aculeae or fixed hairs are confined to the basal area and are most numerous toward costa, especially in the basal area of the cell, only a few scattered elsewhere near base. The aculeae vary in shape from short and narrowly conical to long and slender. The distribution of aculeae in the hind wing is similar to that of the fore wing — all are confined to the basal area.

Fore and middle pairs of legs smooth; hind tibiae hairy, hairs spreading or somewhat appressed, middle spurs near base, unequal, inner spur sometimes nearly equaling tibia, apical spurs short.

Abdomen of females tapering to a more or less slender tip, the lobes of the ovipositor clothed with blackish peg setae often clearly visible, especially in paler-colored species. Abdomen of males shorter and more slender. The denuded abdomen presents some structures which may yield characters of diagnostic value: sclerotized structures present on segments 1 and 2; a densely setose sclerotized area of varying extent and shape near the posterior dorsal margin of segment 7 in the female (fig. 139a). In females, the posterior

dorsal and lateral margins of the sclerotized basal half of segment 8 are margined with short, often minute, evenly spaced setae (not shown on the figures); the posterior membranous half of 8 and the basal area of 9 usually telescoped, but when the membranous section of 8 is drawn out, an ear-like aspect results (figs. 129, 131, 132). In males lateral tufts of specialized scales may be present on segment 8 (fig. 94, sockets only shown).

Within the genus, great diversity of male genitalia necessitates division into several well-defined groups. However, certain elements, though sometimes greatly modified, may be recognized. Within each group, detailed descriptions of these modifications will be presented, with distinguishing characters of the group.

Vinculum sometimes a heavy, fully sclerotized broadly produced band (figs. 91, 92, 94, 95), sometimes sclerotization confined to anterior margin as a narrow band, which may be widely or acutely angled, and sometimes produced as a slender prong (saccus) of various lengths (figs. 79, 84, et al.); harpes more or less fused with vinculum, roughly triangular, and setose within, rarely slender, almost rod-like, basal costal angles produced as free arms, herein termed costal prongs, cucullus and sacculus not differentiated, or (in miners of Compositae) divided, with costal area developed into heavily sclerotized teeth (figs. 90, 91, 93, et al.); juxta sometimes present; transtilla present, a narrow band sometimes weak or broken in the middle, or its function taken over by the sclerotized teeth of the harpe, or rarely absent; anellus a weakly sclerotized cylinder, sometimes spinulose, sometimes with elaborate cuticular outgrowths; aedeagus forked, the orifice usually at or near the base of the forks; forks simple or with characteristic cuticular outgrowths; vesica often spinulose, rarely with cornutus; gnathos absent; socii absent in the typical groups (miners of *Quercus* and *Castanea,* and Rosaceae), and in miners of *Ceanothus,* present in miners of Compositae and Malvaceae; uncus bifurcate.

The female genitalia possess a single (monotrysian) sex opening, located on the membranous anterior half of segment 9; no definitive genital plate; ovipositor lobes clothed with short, thick, and dark-pigmented modified setae, herein termed *peg setae*; a second pair of lobes, lateral and anterior to the ovipositor lobes, bearing short, thick setae, and long slender setae; ductus bursae enlarged in segment 7, its surface often microscopically spinulose; no definite signum, but spinules or minute tubercles may be present in the bursa copulatrix (figs. 120, 143); posterior apophyses long, often enlarged at tip; ventral anterior margin of segment 8 dividing into two arms or produced and then forked (*patibulum* [1]), the tip of each arm articulating with an anterior apophysis in a groove about midway of its length; arising from the dorsum of segment 8 at or near the junction of the sclerotized basal half with the membranous posterior half, a pair of rods (the *prela* [1]), their bases broadly

[1] The terms, "patibulum" and "prelum" were suggested by Dr. J. F. Gates Clarke for these unique structures of the female genitalia.

attached and weakly sclerotized, the distal slender portion strongly sclerotized; their tips press against the enlarged portion of ductus bursae and may touch a strongly sclerotized small depressed area in the ductus (figs. 137, 141).[2]

In the male genitalia, the aedeagus usually affords the best specific character in those groups which do not show a great degree of specialization and divergence from the typical form. The female genitalia of the several groups are remarkably uniform in structure (only the Malvaceous feeders differ from the general picture), and hence present few characters of diagnostic value for separation of the groups. The relative sizes of the ovipositor and lateral lobes and their armature, the length of the posterior apophyses, the shape of the eighth sternite and patibulum, and characters of the prela aid in discriminating species.

Life History

The larvae are miners throughout larval life and pupate within the mine, usually in a loose or ill-defined cocoon. There are usually no well-defined broods; mining larvae of most of the species can be found throughout the season.

The egg is deposited on the upper side of the leaf, rarely on the underside. It is elliptic in shape and cemented to the leaf and usually covered with an adhesive more or less iridescent material, which encircles the egg in a broad band on the leaf.

Upon hatching, the larva goes directly into the leaf tissue. At the beginning of the mine, contiguous to the egg, is a minute, short, translucent area, in which all green leaf tissue is consumed. The mines may expand in one direction (trumpet mine, fig. 47), or enlarge into a blotch (figs. 40, 46, 48, 53) which may obliterate the early translucent area. The larva loosens the upper epidermis (rarely the lower), feeding directly beneath it, consuming all of the leaf tissue except a small amount lying over the lower epidermis. In a few species, especially the Composite feeders, all green leaf tissue is eaten, leaving only the upper and lower epidermis in the greater part of the mine. Except in a few species, the frass is ejected through

[2] Structures homologous with the prela occur in other families with the single sex opening, but lack the specialized development present in *Tischeria*. Davis (1967) refers to them as "a pair of slender apodemes," and shows them as detached structures. Busck (1931) refers to them as "two chitinous rods," shown lying in segment 7.

a circular hole at the beginning of the mine.

Mines may be variously placed over the leaf surface, often along the margin. The position and the form of the mine are characteristic of a species. Thus, mines may be diagnostic and should be associated with the reared specimens.

The larvae spin throughout larval life, the loosened epidermis but very little wrinkled except in the later stages, when it may be drawn into a series of fine wrinkles, bending the leaf; if the mine lies at the leaf margin, the leaf is rolled, partially hiding the mine (figs. 26, 38, 45). In many mines, a slightly raised and more densely silken-lined area narrows toward the beginning of the mine, where the circular hole for the ejection of frass is located. Instead of this slightly elevated runway, the larvae of some species construct a circular silken-lined "nidus," its surface slightly convex, to which they retreat when alarmed or not feeding. This "nidus" is usually more conspicuous on the upper side of the leaf (figs. 42, 48, 53) or rarely on the lower side (fig. 49). The cocoon is elongate and not dense and is placed beneath the wrinkled epidermis, or within the "nidus." Upon emergence, the pupa is thrust through the epidermis.

Larvae. — Moniliform viewed from above, flattened. Head strongly depressed, rounded or sometimes narrowed anteriorly; mouthparts of the biting type, but modified. Functional thoracic legs absent, their position indicated by minute humps bearing a few minute setae; abdominal segments 3, 4, 5, and 6 with each proleg represented by transverse rows of rudimentary crochets; abdominal segments dorsally with two pairs of short connate setae. (figs. 22, 23, 24, 25.)

Pupa (figs. 19, 19a, 19b, 20, 21). — Incomplete, all appendages free, abdominal segments 3 to 7 movable in the male, 3 to 6 in the female. Abdominal segments with patches or bands of dorsal spines; setae long with forked tips (Sections I, II), short with acute tips (Sections III, IV, V); dorsal setae of movable segments often approximate; cremaster of two heavy dorsally directed hooks; the single sex opening of the female between segments 8 and 9. Vertex usually rounded, rarely with an anteriorly projecting slender tubercle (figs. 19, 19a). Prothorax narrow, metanotum nearly equaling mesonotum.

In the European fauna, the known species of *Tischeria* are confined to members of the Fagaceae and Rosaceae. In our fauna, several additional food plant families are represented: Fagaceae with 20 species, Rosaceae with 10 species, Compositae with 11 species, Rhamnaceae with 4 species, Malvaceae with 2 or 3 species,

Ericaceae with 1 species. In India, three additional food plant families are recorded: Tiliaceae, Combretaceae, and Sterculiaceae.

Several of the American species of *Tischeria* are widespread; for example, *T. citrinipennella* ranges from Texas northward in the interior to Ontario and Quebec and eastward to the Atlantic Coast as far north as Nova Scotia; *T. clemensella,* from Texas to Arkansas and Ohio; *T. helianthi,* described from Texas, follows the Mississippi Valley and ranges into the Appalachian Plateau of southern Ohio; *T. sulphurea,* described from Texas, appears to follow the Coastal Plain into New Jersey; *T. mediostriata,* a miner in leaves of deciduous oaks, is known from Colorado to California, and also in the State of Washington. The ranges of many species, especially those of Arizona and southern California, correspond to the distribution of specific food plants.

The genus *Tischeria* appears to be an isolated genus. Although specialized and with reduced venation, certain characters ally it to the primitive forms. These are the single sex opening in the female, the prela of the female genitalia, the relatively large metathorax, and the presence of aculeae or fixed hairs on the wings. These last are not uniformly distributed over the whole wing surface as in the more primitive forms, but are confined to the basal area, and are not always typical.

In the present treatment, the species of *Tischeria* are grouped into five sections, based on food plants and genitalic structure. With rare exceptions, the species feeding on members of each plant family possess distinctive characters in common.

Although the species of Sections III, IV, and V diverge widely in genitalic characters from the typical form, as exemplified by the European species and the American species of Sections I and II, the habitus is that of *Tischeria.* If new genera were erected for these atypical species, dissection would be necessary to assure correct position. The conservative course is followed here.

Keys for specific determination are presented in each section.

Section I

Species 1 to 20

All of the species of this section are miners of leaves of *Quercus* and *Castanea*. Fore wings orange or lemon yellow, rarely whitish, more or less dusted with darker scales, which may be concentrated along the outer half of the costa, and may darken the apical area, and sometimes form an ill-defined mark at tornus. Male genitalia: harpe inwardly clothed with setae, these usually short, long in a few species, or rarely stout and broad at base; anellus cylindrical, usually microscopically spinulose, rarely with larger spines (fig. 58a), rarely bilobed ventrally (fig. 61b), atypical in *quercitella* and *elongata* (figs. 76, 77); forks of aedeagus narrow or broad, sometimes smooth, sometimes spinulose, often with curved, acute, tooth-like cuticular outgrowths, rarely densely clothed with minute scale-like outgrowths; uncus bifurcate, forks acuminate, curved ventrad (when viewed laterally), erect and not tapering in *quercitella* and *elongata*. Female genitalia: ovipositor lobes densely clothed with peg setae, which are usually short and thick and dark-pigmented, rarely slender; lateral lobes with mingled short thick setae and long fine setae; sternite of segment 8 variable, sometimes reduced to a narrow, posteriorly angled band, the arms of the patibulum then appearing as anterior prolongations of the band; prela differing in size and length, thus aiding in specific separation.

The pupae (with the exception of *T. quercitella*) have the body setae long and forked at the end (fig. 19), and Mosher (1916).

Key to the Species of Section I Based on Coloration and Markings [3, 4]

1. Fore wings white or whitish, faintly tinged with pale straw or lemon yellow 2
   Fore wings some shade of yellow, ocherous, orange ocherous or brownish ocherous 3
2. Apical area of fore wing reddish, scales fuscous-tipped ..... (10) *purinosella*
   Fore wing uniformly colored, scales iridescent whitish at base, minutely tipped with ocherous ..... (5) *lucida*
3. Hind wings of the male as wide as the fore wings, at least in basal half 4
   Hind wings of both sexes or in female only (Species 13) narrower than the fore wings, usually half their width, sometimes almost acicular 6
4. Hind wings abruptly narrowing to acute apex 5
   Hind wings evenly lanceolate, both margins convex ..... (17) ♂ *sulphurea*
5. Costal margin of hind wing abruptly bent downward at three-fourths and joining dorsal margin at an acute angle, cilia long from base to three-fourths, thence to apex very short ..... (18) ♂ *zelleriella*
   Hind wing as wide as fore wing in the basal half, then abruptly tapering to the acute apex ..... (13) ♂ *clemensella*
6. Fore wings uniformly colored without perceptible dark dusting except in the apical area; no accumulation of dark scales forming spots or streaks, no contrastingly paler areas, but the wings may shade from pale ocherous at base to orange or brownish ocherous at apex 7
   Fore wings not uniformly colored 13
7. Hind wings dark grayish fuscous ..... (18) ♀ *zelleriella*
   Hind wings not dark fuscous, but they may be tinged with fuscous 8
8. Hind wings wide, but not equaling fore wings, rapidly tapering to the very acute apex ..... (13) ♀ *clemensella*
   Hind wings one-half or less the width of the fore wings 9
9. Head white or whitish, sometimes pale ocherous; wings usually uniformly brownish or orange-ocherous, apex of fore wing not noticeably darkened 10
   Head not white or whitish, fore wings shading from ocherous to orange-ocherous or brownish ocherous, or scales unevenly darker tipped over entire surface 11

[3] Omitted from the key: female *sulphurea*.

[4] Because of the similarity of many of the species and variation within a species, it may not always be possible to identify material, unless reared.

10. Wing expanse 6.5 to 7 mm ..... (8) *concolor*
    Wing expanse 5 to 6.5 mm ..... (9) some *simulata*
11. Scales of fore wings pale ocherous, unevenly tipped with orange over the entire surface, thus clouded; dark-tipped scales in apical area and at apex ..... (7) *subnubila*
    Fore wing shading from paler base to orange ocherous or brownish ocherous 12
12. Hind wings pale gray; cilia pale gray, reddish tinged; somewhat wider and less acute in female ..... (15) most *castaneaeella*
    Hind wings whitish, very narrow, acute, almost linear in male .... (16) *perplexa*
13. Median area of fore wings pale yellow or pale ocherous, thus contrasting with costal and dorsal margins 14
    No contrasting median area, but costa may be darkened; dark-tipped scales form fuscous patches and streaks 17
14. Pale median area well-defined, no dark dusting along termen 15
    Pale median area often obscured by dusting; a band of dark-tipped scales along termen to tornus; hind wings yellow ..... (3) *consanguinea*
15. A broad usually well-defined lemon-yellow stripe from base to two-thirds; a patch of dark dusting at tornus, a scattered line of dark scales at apex; western ..... (2) *mediostriata*
    Median pale area not as sharply defined 16
16. Hind wings of the male with a brownish fuscous basal patch on the upper side; eastern ..... (1) *citrinipennella*
    Hind wings without such dark basal patch; fore wing with a patch of dark dusting at tornus ..... (4) *badiiella*
17. Costal margin darkened, the darker color narrowly spreading onto the wing surface at the middle or apical third of wing, no appreciable dark dusting, no tornal patch 18
    With conspicuous and contrasting dark dusting in the apical area and along termen or with a tornal patch of dark dusting 20
18. Dark scales of outer half of costa with a perceptible purplish tinge; mine translucent, frass retained ..... (14) *fuscomarginella*
    Dark scales of outer half or outer third of costa without such purplish tinge; mine not translucent 19
19. Larval mine with crescentic markings; frass retained .... (15) some *castaneaeella*
    Larval mine at margin of leaf, wrinkled and leaf rolled; frass ejected .... (9) some *simulata*
20. A tornal patch of dark dusting, no accumulation of dark or black-tipped scales in the apical area nor forming a band along termen 21
    Outer third or outer sixth of wing including a band along termen occupied by black-tipped reddish scales 22

21. Scales of entire wing surface tipped with brown, producing a finely dusted aspect ..... (19) *quercitella*
Fuscous scales unevenly sprinkled over the wing surface ..... (20) *elongata*
22. A reddish streak from middle of costa to tornal patch separates the basal pale ocherous area from the area of black-tipped reddish scales ..... (12) *arizonica*
Black-tipped reddish scales confined to apical area and a band along termen 23
23. Wing to apical area except along costa contrastingly paler than apex and termen; band along termen wide ..... (6) *distincta*
Scales of basal area ocherous, but brown-tipped, thus not sharply contrasting with the apical area; band along termen usually narrow ..... (11) *discreta*

Key to the Species of Section I Based on Male Genitalia

1. Genitalia atypical for the section (figs. 76, 77) 2
Genitalia typical for the section 3
2. Sacculus of harpe with an elongate lobe ..... (19) *quercitella*
Sacculus of harpe without a lobe ..... (20) *elongata*
3. Forks of aedeagus smooth, without perceptible armature; some raised streaking or wrinkling may be present 4
Forks of aedeagus armed with cuticular outgrowths (spinules, teeth) 11
4. Forks of aedeagus with streaking simulating spinules or fine wrinkles 5
Forks of aedeagus smooth 7
5. Forks of aedeagus with a few fine wrinkles ..... (13) *clemensella*
Forks of aedeagus with fine streaking 6
6. Forks of aedeagus quadrate ..... (3) *consanguinea*
Forks of aedeagus rounded at apices ..... (1) *citrinipennella*
7. Vinculum not produced anteriorly 8
Vinculum produced as a short rod ..... (7) *subnubila*
8. Apex of costa of harpe acute, setae long ..... (14) *fuscomarginella*
Harpe rounded at apex 9
9. Vinculum acutely angled, with a point bending to the left; forks of uncus broad and swollen for two-thirds their length ..... (6) *distincta*
Angle of vinculum rounded, without projecting point, forks of uncus not swollen toward base 10
10. Anellus an elongate cylinder, forks of aedeagus slender at base, widening to rounded apices ..... (8) *concolor*
Anellus a short cylinder, forks of aedeagus parallel-sided .... (9) *simulata*

11. Each fork of aedeagus bearing a single conspicuous sharp tooth 12
    Armature of forks of aedeagus not as above 13
12. Vinculum little produced; spinules of anellus becoming smaller toward base ..... (17) *sulphurea*
    Vinculum longer produced; spinules of anellus all of one size ..... (18) *zelleriella*
13. Forks of aedeagus with pointed scale-like cuticular outgrowths 14
    Cuticular outgrowths not scale-like 15
14. Forks of aedeagus broad, cuticular outgrowths closely appressed, vinculum produced as a short rod ..... (2) *mediostriata*
    Forks of aedeagus narrow at base, outgrowths not closely appressed, vinculum produced as a long slender rod, anellus with lateral lobes ..... (4) *badiiella*
15. Each fork of aedeagus with rows or groups of large conspicuous teeth 16
    Forks of aedeagus without such teeth, but with minute spinules 19
16. A long row of sharp teeth, larger toward apex of fork .... (11) *discreta*
    Teeth not as above 17
17. A group of a few large curved blunt teeth, setae of harpe spine-like, vinculum long produced, the tip enlarged ..... (12) *arizonica*
    A curved row of sharp teeth near or above middle, setae of harpe normal 18
18. Vinculum short-produced, forks of uncus long ..... (15) *castaneaeella*
    Vinculum not produced, forks of uncus short ..... (16) *perplexa*
19. Stalk of aedeagus very long, forks narrow, spinules smaller and closer together toward base of forks ..... (10) *purinosella*
    Stalk of aedeagus shorter, forks broad, clothed with minute spinules and serrate on outer margins; anellus elongate ..... (5) *lucida*

Key to the Species of Section I Based on Female Genitalia [5]

1. Sclerotized portion of sternite of segment 8 reduced to a narrow, parallel-sided, posteriorly angled band, the arms of the patibulum appearing as anterior prolongations of the band 2
   Sclerotized portion of sternite of segment 8 not thus greatly reduced, but it may be narrowed midventrally, almost appearing divided 8
2. Posterior apophyses broadly expanded at tips (see also sp. 12, couplet 9) 3
   Posterior apophyses but little enlarged at tips 7
3. Peg setae short and close together, in contact 4
   Peg setae separated 5

[5] Omitted from the key: *sulphurea* Frey and Boll, *elongata* Walsingham.

4. Peg setae very small; prela small and short ..... (2) *mediostriata*
   Peg setae larger; prela moderate in size, tapering to slender apical third ..... (3) *consanguinea*
5. Sclerotized band of posterior margin of segment 8 obtusely angled midventrally and bent outward laterally; prela large 6
   Sclerotized band of segment 8 acutely angled; prela very small ..... (7) *subnubila*
6. Sclerotized band of segment 8 laterally right angled, midventrally produced; heavy setae of lateral lobes as thick as the peg setae ..... (13) *clemensella*
   Sclerotized band of segment 8 bent outward but not angled laterally; all setae of lateral lobes slender ..... (10) *purinosella*
7. Peg setae pointed, fine setae of lateral lobes short, hooked; prela large .... (8) *concolor*
   Peg setae pointed, fine setae of lateral lobes long and straight; prela small ..... (9) *simulata*
8. Entire sternite of segment 8 strongly sclerotized, posterior midventral margin with a sharp thorn-like process ..... (19) *quercitella*
   Not as above; no thorn-like process 9
9. Sclerotized portion of segment 8 reduced posteriorly to an acutely angled band, but expanding before origin of arms of patibulum ..... (12) *arizonica*
   Not as above 10
10. Sclerotized portion of segment 8 abruptly narrowing in the middle and appearing divided 11
    Sclerotized portion of segment 8 not thus narrowed and not appearing divided 14
11. Setae of lateral lobes stout; prela very large ..... (1) *citrinipennella*
    Most of the setae of lateral lobes slender; prela small or very slender 12
12. Ovipositor and lateral lobes subequal; prela slender, bases narrowed .... (4) *badiiella*
    Ovipositor lobes larger than the lateral lobes; prela small 13
13. Posterior apophyses expanded at tips; prela very small, scarcely projecting into segment 7 ..... (5) *lucida*
    Posterior apophyses but little expanded at tips; prela not very small .... (14) *fuscomarginella*
14. Sclerotized portion of segment 8 crescent-shaped, arms of patibulum slender at origin; prela large ..... (6) *distincta*
    Posterior margin of segment 8 laterally obtusely angled 15
15. Arms of patibulum abruptly narrowed near tips, broad at origin 16
    Arms of patibulum gradually narrowing distad 17

16. Peg setae pointed, posterior apophyses slender, scarcely enlarging at tips ..... (15) *castaneaeella*
    Peg setae small, truncate, closely placed, posterior apophyses somewhat enlarged at tips ..... (16) *perplexa*
17. Segment 8 with a broad median posterior lobe; peg setae rounded and closely placed; heavy setae of lateral lobes dark-pigmented .... (11) *discreta*
    Median lobe of segment 8 slight; peg setae separated; setae of lateral lobes slender ..... (18) *zelleriella*

(1) **Tischeria citrinipennella** Clemens (Figs. 1, 7, 26, 58, 58a, 106.)

1859. *Tischeria citrinipennella* Clemens, Proc. Acad. Nat. Sci. Phila.: 324. Type ♂, Easton, Pennsylvania, [ANSP, Type No. 7535].
1871. *Tischeria citrinipennella* Chambers, Can. Ent. III: 208.
1872. *Tischeria citrinipennella* Stainton, Tin. No. Am., pp. 39, 80, 82.
1891. *Tischeria citrinipennella* Walsingham, Ins. Life, III: 387.
1903. *Tisheria citrinipennella* Busck, Proc. Ent. Soc. Wash. V: 191.
1923. *Tischeria citrinipennella* Forbes, Mem. 68, Cornell Univ. Agric. Exp. Sta., p. 158.
1933. *Tischeria citrinipennella* Braun, Trans. Am. Ent. Soc. LIX: pp. 238, 253, 258.
1873. *Tischeria quercitella* Frey and Boll (not Clemens), Stett. Ent. Zeit. XXXIV: 221.
1878. *Tischeria quercitella* Frey and Boll (not Clemens), Stett. Ent. Zeit. XXXIX: 254.
1890. *Tischeria quercitella* Walsingham (not Clemens), Ins. Life II: 324.
1877. *Tischeria quercivorella* Chambers, Cin. Quart. Journ. Sci. II: 109. Type ♂, Kentucky [MCZ].
1878. *Tischeria quercivorella* Chambers, Bull. Geol. and Geogr. Surv. of Terr. IV: 97.
1891. *Tischeria quercivorella* Walsingham, Ins. Life III: 387.
1903. *Tisheria quercivorella* Busck, Proc. Ent. Soc. Wash. V: 191.

Face yellow, scales of tuft darkening toward tips; thorax and fore wings pale yellow, wings shading to brownish orange in the apical fourth of the wing, the brownish color extending to base along the extreme costal margin, and to tornus, this brownish color somewhat variable in extent; sometimes a few darker scales at apex, cilia concolorous; underside of fore wing of male with a discal elongate dark brownish fuscous patch at base. Hind wings yellowish white in female, grayish tinged in male, with a brownish fuscous basal patch on the upper side, sometimes produced as a point; cilia concolorous. Costal margin of the hind wing in the female slightly convex, especially toward base. Legs pale yellowish, with faint fuscous dusting outwardly. Abdomen beneath with fuscous dusting on the basal two-thirds.

Alar expanse 8 to 9 mm.

Male genitalia (figs. 58, 58a). Vinculum produced as a short point; harpes with short setae; surface of anellus clothed with microscopic spinules with two clusters of larger spinules; forks of aedeagus flat, expanding apically, vesica densely clothed with microscopic broad spinules; forks of uncus widely separated, membrane between not notched.

Female genitalia (fig. 106). Ovipositor lobes larger than lateral lobes, lateral lobes with stout setae; sex opening rounded, margins sclerotized; posterior apophyses greatly expanded at tips; arms of patibulum broad posteriorly; prela large, broad in basal two-thirds, more than half the length of the anterior apophyses.

Specimens examined. — Approximately 80 ♂, 80 ♀.

NOVA SCOTIA: Carleton, 1 ♀, *Quercus borealis* [CNC].

QUEBEC: Valtetreau, 1 ♀, *Quercus borealis* [CNC].

MASSACHUSETTS: Barnstable, 3 ♂ [C. P. Kimball]; Martha's Vineyard, 2 ♂, 2 ♀ (F. M. Jones) [USNM].

PENNSYLVANIA: Easton, ♂ type [ANSP]; Charter, 1 ♂, on chestnut [USNM]; Cook Forest, 2 ♂, on *Castanea* [AFB]; West Chester, 1 ♂, on *Quercus borealis* [CNC].

NEW JERSEY: Vicinity of New Lisbon, 11 ♂, 12 ♀, reared on several species of oak, including black oak, white oak, *Q. marilandica*, scrub oak, most of them accompanied by the typical mines; 8 ♂, 5 ♀, "Leaf miner on willow oak. Rolled edge of leaf." [ANSP Darlington Collection].

DISTRICT of COLUMBIA: 2 ♂, "bred, willow oak" (C. R. Ely) [USNM].

VIRGINIA: Falls Church, 2 ♂, *"Quercus minor"*; Kearney, 1 ♀, reared *"Castanea dentata"* (mine with specimen); Great Falls, 1 ♂ on *"Q. rubra"* [USNM].

NORTH CAROLINA: Durham, 1 ♂, 2 ♀, *Quercus phellos* (Wm. Haliburton Coll.) [CNC]; Balsam, 1 ♀ [AFB].

ONTARIO: Simcoe, 3 ♂, 6 ♀, *Quercus rubra* (red oak), 1 ♂ *Castanea dentata,* 1 ♀, *Quercus coccinea* (Freeman & Lewis) [CNC]; Marmard, 5 ♂, 5 ♀, *Quercus borealis* (F. & L.) [CNC]; Normandale, 1 ♂, 3 ♀, *Castanea dentata,* 1 ♂, *Quercus rubra* (F. & L.) [CNC]; Bells Corners, 5 ♂, 2 ♀, reared on *Q. borealis* (F. & L.) [CNC]; Pt. Pelee, 4 ♂, 2 ♀, *Quercus borealis* (F. & L.) [CNC].

NEW YORK: Ithaca, 7 ♂, 6 ♀; Newfield, 2 ♂, 1 ♀ [R. W. Hodges].

WEST VIRGINIA: Cooper's Rock State Park, 1 ♀ on *Castanea;* Lost River State Park, 3 ♀ on *Quercus ilicifolia* [AFB].

OHIO: Cincinnati, 5 ♂, 2 ♀, rearing record B. 211 on *Q. imbricaria,* 1 ♂, 1 ♀, "on oak" [AFB]; Cincinnati, 2 ♂, 2 ♀ [USNM]; Brown County, 3 ♂, 2 ♀ on *Q. palustris* [AFB]; Adams County, 3 ♂, 2 ♀ on *Q. palustris, Q. imbricaria* and *Castanea* [AFB].

KENTUCKY: Laurel County, 1 ♂, 1 ♀; Berea, 1 ♂ on *Castanea;* Letcher County, 1 ♂, on *Castanea;* Carter County, 1 ♂, 1 ♀ on *Q. coccinea;*

Mammoth Cave N. P., 5 ♀ on *Q. borealis maxima* [AFB].

INDIANA: Jennings County, 1 ♂, 2 ♀ on *Q. palustris* [AFB].

MISSOURI: "C. Mo.", 1 ♀, "on laurel oak", with mine, 1 ♂, 1 ♀ [USNM].

ARKANSAS: Devil's Den State Park, Washington County, Ark., 2 ♂ [USNM].

TEXAS: A ♀ specimen without head or abdomen, labeled *Tischeria quercitella,* presumably from Boll [USNM].

The larvae are miners in leaves of a number of species of *Quercus,* especially *Q. imbricaria* Michx. wherever this species occurs, and of *Castanea dentata* (Marsh.) Borkh. whenever sprouts persist. The upperside mine (fig. 26) lying along the margin of the leaf, is usually very elongate, at first a narrow blotch, but soon longitudinally wrinkled, and the leaf curled over it, hiding most of the loosened epidermis. There are usually three generations in a year. Mining larvae may be found in late June or early July, late July or early August, the summer broods more or less overlapping; a third brood becomes full-grown in October, passing the winter in the larval state, transforming to pupae in early spring; emergence of imagoes of the overwintering generation in April or early May.

Tischeria citrinipennella is the most widespread of the oak-feeding species, probably occurring throughout the central and eastern portions of the United States and Canada (except the extreme southeast) wherever species of *Quercus* are found.

It is apparent from Stainton's and Walsingham's remarks under *Tischeria citrinipennella* that Clemens had before him examples of *T. citrinipennella*, as represented by the type in the Academy of Natural Sciences, and of the species subsequently described by Chambers as *badiiella.* Frey's remarks under *Tischeria quercitell*a all refer to *T. citrinipennella*; this misidentification is attested by a specimen in the United States National Museum from Boll and labeled *Tischeria quercitella;* it is a female *T. citrinipennella* lacking head and abdomen.

(2) Tischeria mediostriata Braun (Figs. 27, 27a, 59, 59a, 107.)

1927. *Tischeria mediostriata* Braun, Trans. Am. Ent. Soc. LIII: 197. Type ♂, North Rim, Grand Canyon, Arizona, reared from mine on leaf of *Quercus gambelii,* rearing record B.1216; allotype ♀, Fredalba, San Bernardino Mountains, California, rearing record B.691, on

Quercus sp. [AFB].

Face whitish, tuft whitish, lateral scales yellowish or brownish; scales of antennal scape whitish to orange-yellow; fore wings orange-yellow, with a broad lemon-yellow stripe (rarely with a scattering of darker scales) from base to two-thirds, its upper edge diverging from costa, and leaving a gradually narrowing stripe of ground color along costa to base, its lower edge lying nearer and parallel to the dorsal margin, leaving merely a narrow stripe of ground color along the dorsal margin; a patch of dark dusting at tornus, sometimes faint, a scattered line of dark scales at apex, middle of costa rarely almost imperceptibly darkened. Underside of the fore wing of male with evenly scattered darker scales over the entire surface. Hind wings about half the width of the fore wings, and slightly convex on both margins; in the male near base a series of dark, almost scale-like short setae. Legs pale whitish yellow. Abdomen yellowish, not dusted beneath.

Alar expanse 8.5 to 9.3 mm.

Male genitalia (figs. 59, 59a). Vinculum produced as a narrow prong; setae of harpe of moderate length; anellus with ventral sinus; stalk of aedeagus but little longer than the broad flat forks, forks clothed with pointed scale-like cuticular outgrowths; forks of uncus well separated, sclerotized margin between the forks slightly concave.

Female genitalia (fig. 107). Ovipositor lobes much larger than the lateral lobes, peg setae small, very short, and in contact; sex opening with margins laterally acutely sclerotized; posterior apophyses greatly expanded at tips; sternite of segment 8 reduced, arms of patibulum slender; prela very small and short.

Specimens examined. — 7 ♂, 48 ♀.

COLORADO: Canyon City, 2 ♀, rearing record B.1441, mining leaves of *Quercus gambelii* Nutt., imagoes July 12, 1934 [AFB].

NEW MEXICO: Sangre de Cristo Mtns., near Cowles, 2 ♀, rearing record B.1798, on *Quercus gambelii* Nutt., imagoes October 15, October 17, 1939 [AFB]; Hell's Cañon, 1 ♀, June 5, 1917, *Quercus alba* (sic.!), (C. Heinrich) [USNM].

ARIZONA: Grand Canyon N. P., ♂ type, rearing record B.1216, mining leaf of *Quercus gambelii,* imago August 6, 1924 [AFB]; Oak Creek Canyon, 2 ♂, 14 ♀, rearing record B.1784 on *Quercus* sp. (probably *gambelii*) [AFB]; Madera Canyon, Santa Rita Mtns., 2 ♀, J. Powell 68F48, on *Quercus oblongifolia* [UCB]; West Fork, 18 mi. SW Flagstaff, Coconino County, 5 ♀, July to September, 1961 (R. W. Hodges) [USNM]; Pine, Gila County, 2 ♀, September 1, 4, 1961 (R. W. Hodges) [USNM].

CALIFORNIA: Fredalba, San Bernardino County, ♀ allotype, 1 ♂, 1 ♀ paratypes, rearing record B.691, on *Quercus kelloggii* Newb. [AFB]; El Dorado County, 1 ♂, 1 ♀, on *Quercus kelloggii,* J. Powell 68K128 [UCB].

WASHINGTON: Ft. Simcoe, Yakima County, 2 ♂, 16 ♀, 1.VIII.62, 2.VIII.62 (J. F. Gates Clarke) [USNM]; White Salmon, Klickitat County, 1 ♀, (J. F. G. C.) [USNM].

The larvae are miners in leaves of several species of deciduous oaks. Recorded food plants are *Quercus gambelii* Nutt., *Q. oblongifolia* Torr., *Q. kelloggii* Newb.; the food plant of the Washington State specimens is probably *Q. garryana* Dougl. The eggs are laid against a vein, either the midrib or a lateral vein. The mine is at first a narrow whitish trumpet enlarging to a blotch which usually attains the margin of the leaf, then lying along it; the loosened epidermis becomes finely wrinkled, the margin of the leaf then rolled over (figs. 27, 27a). Mining larvae were collected during July and August. In Oak Creek Canyon, Arizona, *T. mediostriata* occurs in great numbers, infesting the oak leaves with as many as four mines to a leaf. In the Black Canyon of the Gunnison National Monument, mines were common on the leaves of *Q. gambelii* in mid August, 1963.

Tischeria mediostriata is the nearest relative of the eastern *T. citrinipennella,* but lacks the fuscous patch on underside of fore wing and base of hind wing. Like *citrinipennella,* the discal area of the fore wing is lemon yellow, but in *mediostriata,* the deeper orange color predominates. Typically, the lemon yellow stripe of the fore wing is sharply outlined; however, specimens occur in which the orange-yellow color encroaches on it, with faint dusting over its surface. By genitalia it is distinct from *citrinipennella.*

(3) **Tischeria consanguinea** new species (Figs. 28, 60, 60a, 108.)

Face yellow, tuft and antennal scape orange yellow. Fore wings lustrous, with a deep orange color predominating, becoming somewhat darker along midcosta; in the apical area with the scales dark-tipped; these dark-tipped scales follow the termen as a more or less continuous band to tornus, where they may be concentrated forming an ill-defined darker patch; discal area of wing paler, yellow, but dusted with orange scales, its limits thus often obscured, and blending with the orange ground color along the dorsal margin, here more or less mixed with yellow scales; cilia orange around apex, becoming pale at tornus. Underside of fore wing of male densely dusted with fuscous scales. Hind wings and cilia yellow. Legs yellow, posterior tibiae lightly dusted. Abdomen yellow above, orange beneath, with slightly darker dusting.

Alar expanse 8.5 to 9 mm.

Male genitalia (figs. 60, 60a). Vinculum obtusely angled; harpe with rather long setae; anellus with shallow ventral sinus; stalk of aedeagus long, forks of aedeagus broad quadrate, spinules not defined, represented by slightly raised streaks, simulating spines; uncus forks broad and swollen in

basal half, separated by a short, narrow sclerotized band, their inner margins strongly sclerotized.

Female genitalia (fig. 108). Ovipositor lobes larger than lateral lobes, peg setae thick, closely placed; sex opening with posterior margin thickened; posterior apophyses expanded at tips; sternite of segment 8 reduced, arms of patibulum slender; prela of moderate length and tapering gradually to slender apical third.

Type. — ♂, 4 mi. W Pasa Robles, San Luis Obispo County, California, emerged IV.10.68, reared from *Quercus dumosa* (J. Powell No. 68040) [UCB].

Allotype. — ♀, 4 mi. W Guatay, San Diego County, California, emerged VII.30.68, reared from *Quercus dumosa* (J. Powell No. 68F67) [UCB].

Paratypes. — 3 ♂, 9 ♀, Guatay, San Diego County, California, reared from *Q. dumosa* (J. Powell No. 68F67) [UCB]; 7 ♂, 10 ♀, Hemet, Riverside County, California, reared from *Q. dumosa* (J. Powell No. 68C84) [UCB]; 3 ♂, 3 ♀, Canada de la Cuesta, Santa Cruz Island, reared from *Q. dumosa* (J. Powell No. 69L43) [UCB]; 1 ♂, McKittrick, Kern County, California, reared from *Q. dumosa alvordiana* (J. Powell No. 68B161) [UCB]; 1 ♂, 4 ♀, Contra Costa County, California, reared from *Q. lobata* (J. Powell No. 68J100) [UCB]; 3 ♂, 2 ♀, Keene, Kern County, California, reared from *Q. turbinella* (J. Powell No. 68D205) [UCB]; 3 ♀, Douglas City, Trinity County, on *Q. garryana* (J. Powell No. 68K54) [UCB].

The larvae are miners in leaves of several species of oak of the white oak group; the specimens of the type series were reared on *Quercus dumosa* Nutt., *Q. dumosa alvordiana* (Eastw.) Jeps., *Q. lobata* Nee, *Q. turbinella* Greene, and *Q. garryana* Dougl.

The long series of imagoes constituting the type series was reared from mines collected on the several species of *Quercus* by Dr. Jerry A. Powell and Paul A. Opler. Three generations in a season may probably be recognized in most of the localities, with some overlapping of generations. Mines were collected in March with emergence of imagoes in April, in June with emergence of imagoes in late June or in July, in early August with emergence of imagoes in late August.

The mine starts as a gradually enlarging, more or less linear tract, then expands into a blotch, which lies along the margin of the leaf (fig. 28). At maturity, the loosened epidermis is drawn into a few fine wrinkles and the leaf is bent over, concealing the mine.

Tischeria consanguinea is closely allied to *T. mediostriata,* and pale specimens may be mistaken for it. However, the distinctly yellow hind wings are a unique and distinguishing character. The obtusely angled vinculum, the long stalk of aedeagus, and the streaked

aspect of the forks of aedeagus differentiate the male; in the female, the large stout peg setae and the longer prela distinguish it from *T. mediostriata.*

(4) Tischeria badiiella Chambers

(Figs. 19, 19a, 19b, 23, 31, 31a, 61, 61a, 61b, 109.)

1875. *Tischeria badiiella* Chambers, Cin. Quart. Journ. Sci., II: 109, 111. Type ? Kentucky [MCZ ?]; Type ♀ Kentucky (?), genitalia slide 9707 J. F. G. C. [USNM].
1875. *Tischeria bodicella* Chambers, Can. Ent. VII: 124.
1872. *Tischeria citrinipennella* Stainton (not Clemens), Tin. No. Am., p. 82.
1890. *Tischeria citrinipennella* Walsingham (not Clemens), Ins. Life II: 305.
1891. *Tischeria badiiella* Walsingham, Ins. Life III: 387, 389.
1920. *Tischeria nubila* Braun, Ent. News XXXI: 78. Type ♂, Winnfield, Louisiana [AFB]. **(New Synonymy.)**
1924. *Tischeria badiiella* Braun, Trans. Am. Ent. Soc. XLIX: 357.

Face and antennal scape white, or faintly ocherous tinged, tuft whitish, head posteriorly and laterally ocherous; antennae whitish, fuscous beneath in male; thorax laterally more deeply colored than the head. Color of the fore wings varying from pale sulphur yellow to orange yellow, and shading to reddish or brownish orange along costa and in the apical third of the wing, where there is scattered dark dusting which usually forms a distinct dark line around apex at the base of the cilia; a patch of dark dusting at tornus, sometimes faint, sometimes obsolete, rarely large and conspicuous; dorsal margin darker than the general ground color, with a few dark-tipped scales scattered along it; the reddish or brownish orange color may spread over the entire wing which is then uniformly colored, but somewhat irrorate; in such specimens the tornal spot tends to be obscured; underside of base of costa of male fuscous. Hind wings and cilia tinged with ocherous, especially toward apex, very narrow in male, somewhat broader in female toward base. Legs pale ocherous, dusted with fuscous outwardly. Abdomen pale ocherous above, with darker, but pale dusting beneath.

Alar expanse 7.5 to 8 mm.

Male genitalia (figs. 61, 61a, 61b). Vinculum abruptly tapering to an acute angle, then produced as a long slender rod; harpes large, greatly exceeding uncus, cucullus indicated; anellus with deep ventral sinus, and two lateral minutely spinulose elongate lobes; stalk of aedeagus long, very slender, forks long, midsection clothed with pointed scale-like cuticular outgrowths; forks of uncus broad, abruptly tapering near tips, narrowly separated at base by a crescent-shaped sclerotization.

Female genitalia (fig. 109). Ovipositor and lateral lobes subequal, peg setae separated, setae of lateral lobes stout; sex opening arched posteriorly; tips of posterior apophyses triangularly enlarged; sternite of segment 8 reduced, arms of patibulum widening in basal third; prela slender, bases narrow.

Specimens examined. — 164, ♂, ♀.

ONTARIO: Simcoe, 2 ♂, 1 ♀, *Quercus alba,* 21.VII to 27.VII.1964 [CNC], 1 ♀, *Quercus alba,* 23.VII.1964 (dusting obscures tornal spot) [CNC].

MASSACHUSETTS: Martha's Vineyard, 2 ♀ [USNM].

NEW YORK: Ithaca, 1 ♂, 1 ♀, V.11, V.21 (R. W. Hodges); 1 ♂ (Beutenmiller Coll.) [USNM].

PENNSYLVANIA: New Brighton, 1 ♂, VI.14.07, 1 ♀, V.18.07 (Merrick Museum) [USNM].

NEW JERSEY: New Lisbon or vicinity, 54, ♂, ♀, emerging from mid May to mid June, 1 ♀, July 31, 1 ♀, Aug. 10; "leaf miner on upper side white oak," "leaf miner on oak," "leaf miner on scrub oak", many accompanied by mines; 1 ♂, "leaf miner on white oak underside, emerged New Lisbon, May 29, 1940" [Darlington Collection, ANSP].

MARYLAND: Hyattsville, 1 ♂, 1907 [USNM].

DISTRICT of COLUMBIA and Falls Church, Virginia: 8, ♂, ♀, various dates, 1885 (probably Riley Coll.) [USNM]; 1 ♀, labeled "8891, on oak, D. C. iss. March 31, 1900" [USNM]; 17, ♂, ♀, several reared on "oak" and some accompanied by mines [USNM].

NORTH CAROLINA: Highlands, Macon County, 2 ♀, Aug. 4, Aug. 10, 1958 (R. W. Hodges) [USNM].

OHIO: Cincinnati, 4 ♂, 6 ♀, reared on *Quercus alba*; Clermont County, 1 ♀, "white oak"; Brown County, 2 ♂, 3 ♀, rearing record B.1093, on *Quercus alba*; Fort Ancient, Warren County, 2 ♂, B.2344, on *Q. alba*; Beaver Pond, Adams County, 2 ♂, 8 ♀, B.1303, on *Q. alba*; Fort Hill, Highland County, 1 ♂, 1 ♀, B.2423, on *Q. alba*, 1 ♂, 1 ♀, B.2403, on *Q. alba*; Shawnee State Forest, Scioto County, 1 ♀, B.2405 on *Q. alba* [AFB].

KENTUCKY: Claryville, Campbell County, 1 ♂, 2 ♀, B.2028, on *Q. alba*; Morehead, Rowan County, 1 ♂, "on oak"; Olive Hill, Carter County, 1 ♂, 1 ♀, on *Q. alba*; Fleming County, 1 ♂, on *Q. alba*; Pulaski County, 1 ♂; Big Black Mtn., Letcher County, 1 ♀, B.1499, on *Q. alba*; Mammoth Cave National Park, 4 ♀, B.2441, on *Q. alba* [AFB].

INDIANA: Switzerland County, 1 ♂, 1 ♀, larva VI.4.36, imago, VI.18.36, reared on *Quercus palustris*; Jennings County, 1 ♂, 2 ♀, on *Q. palustris,* larva X.19.35, imagoes IV.1.36 [AFB].

ILLINOIS: Putnam County, 1 ♀, "March 19, 1939. *Quercus alba*" (M. O. Glenn). Mine accompanying specimen. Slide No. 3084, J. F. G. C. [USNM].

MISSOURI: Central Missouri, 3 ♀, two with mines [USNM]; 1 ♂, (no locality), "on Post oak" [USNM].

ARKANSAS: Devil's Den State Park, Washington County, 16, ♂, ♀, June 16 to July 23, 1966 [USNM]; Washington County, 1 ♂, 1 ♀, Aug. 6, July 28 [USNM].

LOUISIANA: Winnfield, ♂ type of *nubila* Braun, 4 ♂, 3 ♀ (paratypes of *nubila*), B.982, reared on *Q. alba* (mines collected by G. R. Pilate), imagoes May 12 to 28; 2 ♀, June 17 [AFB].

With few exceptions the larvae of *Tischeria badiiella* are confined to *Quercus alba* L. as a food plant. The mine is variously placed on the leaf, with the egg against a vein. On white oak (*Q. alba*), the loosened epidermis is white and retains this character throughout the feeding period. In the earlier stages, the epidermis is but slightly wrinkled (fig. 31a), later and at maturity, the epidermis near the beginning of the mine is drawn into several fine wrinkles, and the leaf somewhat bent, drawing the two adjacent veins toward one another (fig. 31). In very young leaves, the epidermis may be torn as the leaf enlarges. The pointed tubercle on the pupal head is a unique character (figs. 19, 19a). There are two or three generations in a year.

The considerable variation in ground color and the amount of dark dusting, the tornal patch sometimes obsolete, and the spreading of the darker orange brown color over the wing surface may render identification of flown specimens doubtful. The specimen from Black Mtn., Letcher County, Kentucky is conspicuously dark dusted at the wing apex, and the tornal spot is larger and darker than in any other specimen examined.

In male genitalia, *T. badiiella* is distinct; the aedeagus, and the anellus with lateral lobes distinguish it from all other species. In the female genitalia, the best distinguishing characters are the slender prela, and the triangularly enlarged tips of the posterior apophyses.

(5) Tischeria lucida new species (Figs. 62, 62a, 110.)

Face white, with an iridescent luster; scales of tuft whitish anteriorly, tinged with ocherous posteriorly, scape of antenna ocherous tinged, antennal shaft whitish, with very narrow fuscous annulations, all with the same iridescent luster. Scales of fore wings iridescent whitish at base, minutely tipped with ocherous, giving the entire wing an almost microscopic iridescent irrorate aspect, especially when viewed at an angle; cilia ocherous, darker than the fore wing along termen; basal half of underside of fore wings of male dusted with brownish ocherous scales, densest toward costa. Hind wings pale fuscous-tinged, iridescent, cilia whitish, becoming ocherous at apex. Legs whitish ocherous, iridescent. Abdomen whitish above, more or less densely dusted with fuscous beneath, especially toward base, anal tuft of male white.

Alar expanse 7 to 7.5 mm.

Male genitalia (figs. 62, 62a). Vinculum angled, pointed; harpe broadening outwardly, setae of moderate length; anellus an elongate cylinder, expanding posteriorly; forks of aedeagus minutely spinulose and serrate on

outer half of margins; tegumen short, uncus forks large, widely separated, sclerotized band between them curved.

Female genitalia (fig. 110). Ovipositor lobes much larger than lateral lobes, and densely clothed with short peg setae; sex opening with sclerotized posterior and lateral margins, lateral sclerotization produced anteriorly; posterior apophyses enlarged at tips; sternite of segment 8 reduced, arms of patibulum becoming slender; prela very small, scarcely projecting into segment 7.

Type. — ♂, Parker Is., Highlands County, Florida, 26-29 May 1964 (R. W. Hodges) [USNM, Type No. 71291].

Allotype. — ♀, Oneco, Manatee Co., Fla. V.14.1953 (Paula Dillman, C. P. Kimball Collection) [USNM].

Paratypes. — 1 ♂, Parker Is., Highlands Co., Florida, 26-29 May 1964 (R. W. Hodges) [USNM]; 1 ♂, Oneco, Manatee Co., Fla. V.11.1953 (Paula Dillman) [C. P. Kimball]; 1 ♂, Siesta Key, Sarasota Co., Fla. V.14.1956 (C. P. Kimball) genitalia slide [USNM]; 1 ♂, Siesta Key, Sarasota Co., Fla. April 12, 1960 (C. P. Kimball) [CPK].

Food plant unknown.

The peculiar iridescence and the almost microscopic irroration will serve to identify this species. The serrate margins of the forks of aedeagus are unique and characteristic of the species.

Through the courtesy of Mr. C. P. Kimball, the allotype and one of the paratypes will be deposited in the United States National Museum.

(6) Tischeria distincta new species (Figs. 29, 63, 63a, 111.)

Face white, forward projecting scales of tuft pale ocherous, dorsal scales of head and antennal scape varying from ocherous to reddish brown; antennal shaft ocherous in female, tinged with brown in male and darkening outwardly, cilia pale. Eyes large. Thorax centrally ocherous, tegulae sometimes reddish with black-tipped scales. Fore wings lustrous, iridescent pale ocherous, costal margin from base nearly to middle of wing narrowly reddish brown, thence, the reddish brown color spreads onto the wing surface as a narrow elongate lobe, occupying the middle third of the costal area, and usually sprinkled with black-tipped scales; costa beyond pale to five-sixths the wing length; a broad band of the reddish color, sprinkled with black-tipped scales, occupies the outer sixth of the wing and extends parallel to termen to the dorsal margin; inwardly this band is margined by a curved streak of black-tipped or nearly black scales from the dorsal margin near tornus and contrasting with the outer area of narrowly black-tipped scales; costal and apical cilia red, becoming paler and ocherous at tornus. Underside of fore wings densely clothed with fuscous scales except in apex and along dorsum in the male; a smaller dusted area in the female. Hind wings and cilia reddish, fuscous tinged. Legs pale ocherous, not dusted. Abdomen ocherous, dusted with fuscous scales except

at posterior margins of segments.

Alar expanse 9 to 9.5 mm.

Male genitalia (figs. 63, 63a). Vinculum acutely angled, with sharp point bending to the left; harpe with most of the inner surface setose; anellus a wide cylinder, microscopically spinulose; forks of aedeagus very long and slender, narrowing and converging toward apex; forks of uncus broad and swollen for basal two-thirds, then abruptly narrow and acute, separated by a sclerotized band, the sclerotization extending along the inner margins of the swollen bases.

Female genitalia (fig. 111). Lateral lobes nearly as large as the ovipositor lobes; entire ventral surface of ovipositor lobes clothed with short peg setae; sex opening arched and posterior margin sclerotized, sclerotization of lateral margins slenderly produced anteriorly; posterior apophyses enlarged at tips; sternite of segment 8 narrow, strongly sclerotized along posterior margin only, arms of patibulum slender; prelum broad, narrowing near apex and sharply acuminate.

Type. — ♂, Madera Canyon, Santa Rita Mts., Arizona, emerged VII.9.68, reared from *Quercus hypoleucoides* A. Camus (J. Powell 68F52) [UCB].

Paratypes. — 10 ♂, 13 ♀, same data as the type, except dates of emergence June 6, July 8 to July 14 (J. Powell 68F52) [UCB]; 1 ♂, Madera Canyon, 5600′, Santa Rita Mtns., Arizona, August 1, 1959 (R. W. Hodges) [USNM]; 5 ♀, Madera Canyon, 4880′, Santa Rita Mtns., July 29 (2 spms.), July 30, August 10, August 21, 1959 (R. W. Hodges) [USNM]. The genitalia of the six flown specimens (R. W. Hodges) agree with the genitalia of the reared series.

The larvae are miners in leaves of *Quercus hypoleucoides* A. Camus. The mine (fig. 29) was collected June 6, 1968 (J. Powell 68F52). The mine is elongate, all green tissue consumed in a narrow linear pale area for about 5 or 6 mm, at the beginning of which may be seen the exit hole for frass (cf. fig. 29); beyond this area, the palisade layers are uneaten, except for a narrow margin of the mine along the edge of the dark longitudinal elevated area. This area is a broad, flat ridge, conspicuously elevated on the upper surface of the leaf. At the terminal portion of the mine, all green tissue is again eaten, with the exit slit of the pupa in this pale area.

Tischeria distincta is one of the most distinct and easily recognized of the oak-feeding species. Occasionally, specimens occur which lack the apical blackish dusting and its blackish margining streak. A male genitalia slide of one of such specimens (June 6, J. Powell 68F52) confirms the identification.

(7) **Tischeria subnubila** new species (Figs. 64, 64a, 112.)

Head and antennal scape varying from whitish to pale ocherous. Scales of the fore wings pale ocherous, tipped with orange over the entire surface, but unevenly so, thus producing a slightly clouded effect, with an accumulation of darker scales beyond the middle of the costa, followed by a paler area; in the apical area of the wing some of the orange scales are dark-tipped, and a few darker-tipped scales lie at the apex. Hind wings very narrow, whitish ocherous (rarely a slight fuscous tinge), cilia faintly orange toward apex. Legs ocherous, posterior tarsi shaded with fuscous. Abdomen brownish orange above, a slight fuscous dusting beneath.

Alar expanse 6.5 mm (type, allotype, and one paratype) to 8 mm.

Male genitalia (figs. 64, 64a). Vinculum angled, shortly produced; harpe with short setae; anellus a broad truncated cone, orifice wide; stalk of aedeagus slender, but little longer than the slender forks; forks of uncus widely separated by a broad crescent-shaped sclerotization.

Female genitalia (fig. 112). Ovipositor lobes larger than lateral lobes, lateral lobes with fine setae mingled with stout setae; sex opening with margins sclerotized and laterally produced; posterior apophyses enlarged at tips; sternite of segment 8 reduced, arms of patibulum slender; prela very small.

Type. — ♂, Carlsbad National Park, New Mexico, rearing record B.1744, on leaf of oak, probably *Quercus grisea* Liebm., imago June 28, 1939 (genitalia slide and figs. 64, 64a) [AFB].

Allotype. — ♀, same data as the type, but date of emergence July 4, 1939 (genitalia slide and fig. 112) [AFB].

Paratypes. — 1 ♂, Madera Canyon, Santa Rita Mtns., Arizona, 4880′, July 5, 1959 (R. W. Hodges) [USNM]; 6 ♀, West Fork, 16 mi. SW Flagstaff, Coconino County, Ariz., Aug. 13 to Aug. 20, 1961 (R. W. Hodges) [USNM].

The mines, on leaves of a species of oak, probably *Quercus grisea* Liebm., from which the type and allotype were reared, were collected June 24, 1939. The whitish mines lie along the margin of the leaf, and at maturity the leaf is rolled over, entirely or nearly concealing the mine.

The ♂ paratype (expanse 6.5 mm) exactly matches the type and allotype; the six female paratypes (expanse 8 mm) show the same characteristic clouded effect of the fore wings, but are somewhat darker. A genitalia slide of one of these females agrees with the slide of the allotype.

The genitalia present no very good distinguishing characters; the small prela of the female, the wide anellus of the male may aid in identification.

(8) Tischeria concolor Zeller (Figs. 66, 66a, 113.)

1875. *Tischeria concolor* Zeller, Verh. Zool.-bot. Ges. Wien XXV: 352. Type ♀, Texas [MCZ].
1878. *Tischeria concolor* Frey and Boll, Stett. Ent. Zeit. XXXIX: 255.
1890. *Tischeria concolor* Walsingham, Ins. Life II: 324.

Face white, rough scales of crown whitish to ocherous, antennal scape ocherous posteriorly. Thorax ocherous, concolorous with the fore wing. The following is a translation from Zeller's description:

"Fore wing dark, — almost clay color ocher yellow, only in the outer third sprinkled with extremely fine brown specks, which however do not make the apex darker. Cilia as pale as on the hind wings.

"Hind wings narrow knife-shaped, finer pointed than in *complanella*, somewhat shining, white, scarcely grayish mixed; cilia as pale, with faint yellowish luster.

"Underside of fore wing pale ocher yellow, on the basal half overlaid with dark gray."

Legs ocher yellow, depth of color variable.

The fore wing of the type is very uniform in color, not shining. From examination of additional specimens, I supplement the original description as follows: fore wings ocherous at base, shading outwardly to brownish ocherous, or sometimes brown, and in the outer half or outer third minutely dark dusted with dark brown-tipped scales, thus appreciably darkening the wing; these dark specimens show more of the yellowish or fuscous tinge on the hind wings.

Alar expanse 6.5 to 7 mm.

Male genitalia (figs. 66, 66a). Vinculum rounded acute; harpe with apex rounded, setae long; anellus an elongate cylinder, minutely spinulose; stalk of aedeagus long, forks slender at base, widening to rounded apices; forks of uncus separated by a narrow, quadrate scleortized band.

Female genitalia (fig. 113). Ovipositor lobes much larger than lateral lobes, peg setae pointed, fine setae of lateral lobes short and hooked; sex opening circular; posterior apophyses long, slender, and scarcely enlarged at tips; sternite of segment 8 reduced, arms of patibulum slender; prela large.

Specimens examined. — 2 ♂, 6 ♀.

TEXAS: ♀ type [MCZ].

ARKANSAS: Devil's Den State Park, Washington County, 1 ♀, 20.V.-1966, 1 ♀, 21.VI.1966 (R. W. Hodges) [USNM].

ILLINOIS: Putnam County, March 9, 1939, 1 ♀, "bred ex oak leaf", mine accompanying specimen (M. O. Glenn) [USNM]. Genitalia slide 3088 ♀, J. F. G. C.

DISTRICT of COLUMBIA: Washington, 2 ♂, 10/5/85 (Riley Coll.) [USNM].

VIRGINIA: Falls Ch., 1 ♀, *Quercus*, iss. 3-13, mine accompanying

[USNM]; Stafford, 1 ♀, VI.5.1962 (R. W. Hodges) [USNM].

The mine, lying along the margin of a leaf of *Quercus* sp., is similar to that of *Tischeria citrinipennella,* but shorter; the curled margin of the leaf may or may not conceal the mine.

The following species closely resembles *T. concolor* and imagoes on casual examination may be mistaken for it.

(9) **Tischeria simulata** new species (Figs. 32, 33, 65, 65a, 114.)

Face and tuft whitish, tinged with ocherous. Thorax ocherous. Fore wings varying from pale ocherous to orange-ocherous, and minutely dusted with darker-tipped scales; in the pale specimens the minute specks are evenly distributed over the wing and are scarcely darker than the ground color; in darker specimens, the darker dusting is more noticeable and may be concentrated along the outer third of costa and in the apical area. Cilia orange tinged opposite apex, paler than the wing from thence to tornus; a scattering of dark scales on the basal half of the underside of the fore wing. Hind wings very narrow, whitish, or tinged with gray, cilia with a faint ocherous tinge. Legs whitish ocherous.

Alar expanse 5 to 6.5 mm.

Male genitalia (figs. 65, 65a). Vinculum angled, the angle scarcely less than a right angle; harpe narrow, costal margin concave, ventral margin curved, setae of moderate length; anellus a short cylinder, spinulose; stalk of aedeagus but little longer than the nearly parallel-sided forks; uncus forks widely separated.

Female genitalia (fig. 114). Ovipositor lobes much larger than lateral lobes, peg setae pointed, stout setae of lateral lobes long; posterior margin of sex opening strongly sclerotized; posterior apophyses somewhat enlarged at tips; sternite of segment 8 reduced, arms of patibulum stout; prela very small.

Type. — ♂, Morehead, Rowan County, Kentucky, reared from mine on leaf of *Quercus alba* (fig. 33), larva X.2.37, imago IV.15.38 [AFB].

Allotype. — ♀, Russelville, Logan County, Kentucky, rearing record B.1839, mine on *Quercus stellata* (fig. 32), imago IX.7.40 [AFB].

Paratypes. — 1 ♀, Fox Mountain, Fleming County, Kentucky, reared from mine on *Quercus alba,* XI.7.37, imago IV.18.38 [AFB]; 1 ♂, Buzzard-roost Rock, Adams County, Ohio, mine on *Q. stellata,* X.11.29, imago IV.27.30 [AFB]; 1 ♂, Adams Lake, Adams County, Ohio, rearing record B.2486, on *Q. alba,* imago VIII.4.69 [AFB]; 1 ♀, Shawnee Forest, Scioto County, Ohio, on *Q. montana,* larva X.31.68, imago IV.20.69 [AFB]; 1 ♂, 2 ♀, Devil's Den State Park, Washington County, Arkansas, VI.18.66 and VII.21.66 (R. W. Hodges) [USNM].

The larva is a miner in leaves of *Quercus alba* L., *Q. montana* Willd., and *Q. stellata* Wangenh. The mine is usually a small blotch

lying at the margin of a leaf (fig. 32); on thinner leaves of *Q. alba,* it may be elongate and the margin of the leaf rolled, partially concealing the mine (fig. 33).

Superficially, *T. simulata* is indistinguishable from *T. concolor,* except by its smaller size. The pale head is a characteristic of both species. By genitalia of both sexes, it is distinct.

(10) Tischeria purinosella Chambers (Figs. 8, 30, 67, 67a, 115.)

1875. *Tischeria purinosella* Chambers, Cin. Quart. Journ. Sci. II: 110. Type, Kentucky [MCZ].
1878. *Tischeria pruinosella* Chambers, Bull. Geol. and Geogr. Surv. of Terr. IV: 97.
1890. *Tischeria pruinosella* Walsingham, Ins. Life II: 325.
1915. *Tischeria purinosella* Braun, Ent. News XXVI: 271.
1907. *Tischeria albostraminea* Walsingham, Proc. U. S. N. M. XXXIII: 224. Type ♂, New York [USNM, Type No. 10356]. **(New Synonymy.)**
1909. *Tischeria albostraminea* Busck, Proc. Ent. Soc. Wash. XI, 102.
1915. *Tischeria albostraminea* Braun, Ent. News XXVI: 271.

Face, tuft, and antennae whitish, faintly tinged with pale straw or lemon yellow. Fore wings of the same whitish straw-color, usually with a faint dusting of dark-tipped scales; a line of purplish or reddish brown scales along costal margin to just beyond the middle of the costa, where it expands into a small somewhat triangular spot, very rarely absent; the apex of the wing reddish, and densely dusted with dark blackish purple, or sometimes black scales; on the dorsal margin, at tornus, a similarly colored spot, separated from the dark apical area by the pale ground color, rarely confluent with it by an extension of the dark apical color along the termen; scattered dark scales usually present along the basal half of the dorsal margin; cilia around apex brownish red, becoming paler toward tornus, but retaining the reddish tinge. Hind wings pale straw-color, usually with a grayish tinge, base of costa thickened with dark fuscous scales, cilia reddish tinged at apex of wing. Legs pale straw-color, dusted with fuscous. Abdomen pale straw-color, sometimes with a dusting of dark scales above.

Alar expanse 6 to 7 mm.

Male genitalia (figs. 67, 67a). Vinculum very obtusely angled; harpe narrow at base, ventral margin concave, setae short; anellus with shallow ventral sinus, microscopically spinulose; stalk of aedeagus long, very slender, forks slender, spined, the spines directed toward base, smaller and closer together toward base; forks of uncus gradually tapering, not acuminate, membrane between with a deeply curved sclerotization.

Female genitalia (fig. 115). Ovipositor lobes much larger than lateral lobes, peg setae slender, setae of lateral lobes slender; posterior apophyses en-

larged at tips; segment 8 narrowly and strongly sclerotized posteriorly, arms of patibulum articulating with anterior apophyses distad of their middle; prela large.

Specimens examined. — 38, ♂, ♀.

KENTUCKY: Type [MCZ].

OHIO: Cincinnati, 11, ♂, ♀, on several species of *Quercus*, including *Q. alba* L., *Q. muehlenbergii* Engelm., and *Q. macrocarpa* Michx. [AFB]; 9, ♂, ♀, some reared, some flown (A. F. Braun) [USNM]; Brown County, 1 ♂, reared on *Q. alba* [AFB]; Fort Hill, Highland County, 1 ♂, on *Q. montana* [AFB]; Peach Mountain, Adams County, 1 ♂ [AFB]; 1 ♂, L. Adams, Adams Co., on *Q. alba,* mine VII.29, imago VIII.6 [AFB].

NEW JERSEY: New Lisbon or vicinity, 4 ♂, 2 ♀, accompanied by mines, "Leaf mines on wh. oak", "upper side", "edge of leaf", May 17 to June 11; 2 ♂, "leaf miner on white oak", June 2, June 12 [Darlington Collection, ANSP].

DISTRICT of COLUMBIA: 1 ♂, 3 ♀, Busck No. 8847, "on oak" [USNM]. Labeled *Tischeria albostraminea* Wlsm.

LOUISIANA: Winnfield, 1 ♂, "on oak" imago V.12 [AFB].

TEXAS: A Chambers' specimen, bearing a number, from Texas [MCZ].

The larvae are miners in leaves of several species of the white oak group, especially *Quercus alba* L., but also *Q. muehlenbergii* Engelm., *Q. macrocarpa* Michx., and *Q. montana* Willd. The small mine, with the loosened upper epidermis white, lies at the margin of a leaf (fig. 30); at time of pupation, the loosened epidermis is drawn into a number of fine ridges, the central part, beneath which pupation takes place, rather sharply delimited. On *Q. alba,* the mine retains its whitish color throughout the mining period. There are several generations in a year; moths from overwintering pupae appear in April; a late generation matures in October.

The whitish ground color of the fore wings, the reddish apex, dusted with dark scales, the reddish scales along costa, and the reddish tornal spot separate *T. purinosella* from all others of the American oak-mining species. Chambers' description of *T. purinosella* apparently was made from a specimen lacking the pronounced reddish color in the apex and in the tornal spot. Specimens reared in Ohio show all gradations from the well-marked condition, as described by Walsingham for *albostraminea,* to specimens agreeing with Chambers' description. A Texas specimen, now in the Museum of Comparative Zoology, and referred to by Chambers (1878), lacks any dark dusting.

Misled by some confusion of labeling in the Museum of Comparative Zoology, I identified this species as *T. badiiella* Chambers. Hence, references to this species as *T. badiiella* in Entomological News (XXVI, 271) are in error.

(11) Tischeria discreta new species (Figs. 34, 35, 36, 68, 68a, 116.)

Face white, forward projecting scales of tuft white, scales of rough tuft and antennal scape ocherous to brownish ocherous. Scales of the fore wings pale ocherous at base, but immediately shading to brownish ocherous, the wings lustrous, with a barely perceptible irrorate aspect; dark brown scales follow the extreme costal margin and at middle of costa narrowly spread onto the wing; apical area and termen brown, evenly dusted with black-tipped scales, thus forming a well-defined band from apex to tornus; a line of more narrowly black-tipped scales projects into the cilia and encircles the apex; cilia brownish ocherous to brown around apex, paler toward tornus; underside densely dusted with fuscous scales, especially on basal third of wing, along costa, and in apex in male, less densely and more evenly dusted in female. Hind wings pale fuscous, with slight ocherous tinge, cilia concolorous. Legs ocherous, more or less densely dusted with fuscous. Abdomen fuscous dusted above and below.

Alar expanse 7.5 to 8 mm.

Male genitalia (figs. 68, 68a). Vinculum angled (a right angle) and short produced; harpe with short setae; orifice of anellus with the ventral margin with a shallow sinus, dorsal margin projecting beyond ventral margin and with a deeper sinus; stalk of aedeagus slender, each fork of aedeagus bearing a row of 9 or 10 sharp teeth, gradually increasing in size toward apex; forks of uncus widely separated, sharply acute when viewed laterally.

Female genitalia (fig. 116). Ovipositor lobes not greatly exceeding lateral lobes, peg setae rounded and closely placed, the heavy setae of the lateral lobes long and dark-pigmented; posterior apophyses long and little enlarged at tips; segment 8 wide, with a posterior median lobe, arms of patibulum short; prela moderate in size, bent at tips.

Type. — ♂, Keene, Kern County, California, reared on *Quercus wislizenii,* V.3.68, emerged V.12.68 (P. A. Opler, J. Powell No. 68E12 [UCB].

Allotype. — ♀, Keene, Kern County, California, reared on *Q. wislizenii,* V.3.68, emerged V.16.68 (P. A. Opler, J. Powell No. 68E12) [UCB].

Paratypes. — 9 ♂, 10 ♀, same data as the type, except dates of emergence from May 1 to May 26; 7 ♂, 6 ♀, 13 ♂, ♀ (not spread), Keene, Kern Co., Calif. reared on *Q. wislizenii,* III.28.68, with dates of emergence in early May (P. A. Opler, J. Powell No. 68C54); 2 ♂, 1 ♀, same data (P. A. Opler, J. Powell 68C56); 2 ♂, 1 ♀, Forest Home, San Bernardino County, California, reared on *Q. wislizenii,* emerged V.12.68 (P. A. Opler, J. Powell 68C82); 1 ♂, Cowell, Contra Costa County, California, reared on *Quercus agrifolia* (J. Powell 68E74); 1 ♂, Mt. Diablo, Contra Costa County, reared from

Quercus chrysolepis, imago, IV.29.1969 [UCB]; 1 ♂, Atascadero, San Luis Obispo County, reared on *Quercus agrifolia,* emerged V.5.68 (P. Opler, J. Powell 68B69.1); 1 ♂, 2 ♀, San Luis Obispo Co., reared from *Quercus suber,* imagoes IV.16, IV.17, IV.27 [UCB]; 1 ♂, El Toro, Orange Co., reared on *Q. agrifolia,* emerged IV.23.68 (P. Opler, J. Powell 68C111 [UCB]; 7 ♂, 7 ♀, Santa Cruz Island, reared from *Q. agrifolia,* mines collected mid March, imagoes in April [UCB]; 2 ♂, Alameda Co., VI.15.08 (G. R. Pilate) [AFB]. Not included in the type series, are flown specimens, representing both sexes, from several localities in Contra Costa County (J. Powell) [UCB].

The larvae are miners in leaves of several evergreen species of *Quercus,* most commonly *Quercus wislizenii* A. DC., and *Q. agrifolia* Née; also *Q. chrysolepis* Liebm. and the exotic *Q. suber* L. In a very young mine on *Q. wislizenii* var. *frutescens,* showing a glistening egg, a short narrow linear mine enlarges into a small blotch in which all green tissue is consumed (fig. 36); the central part of the mature mine (figs. 34, 35) with a broad tubular silken-lined longitudinal ridge, where the lower epidermis is raised, the upper epidermis only slightly raised; thus the mine viewed from above is nearly flat, with no wrinkles; in this area, some of the green tissue is not eaten. The area in which all green tissue is consumed may extend beyond and a little on either side of the silken-lined tube (fig. 34). The slit through which the pupa is thrust is placed at the margin of the ridge.

Tischeria discreta resembles *T. distincta* in markings, but the fore wings are darker, more brownish ocherous. The different genitalia, especially the aedeagus of the male, at once separate it from that species.

(12) **Tischeria arizonica** new species (Figs. 37, 37a, 69, 69a, 117.)

Face and forward projecting scales of tuft whitish ocherous; scales of scape of antenna and crown usually somewhat darker; eyes large. Fore wings dull pale ocherous, sprinkled with fuscous scales, this color occupying the discal area of the wing from middle of costa to tornus; from middle of costa (or just before) a reddish streak, marking the inner limit of the reddish outer third of the wing, passes across the wing to the tip of a tornal spot of variable size dusted with blackish-tipped scales (sometimes these scales are not blackish-tipped and the tornal spot is not differentiated); this division of the wing into light and dark areas is the distinguishing character of the species; scales in the reddish outer third of the wing near apex dark-tipped, with a more or less distinct line of dark-tipped scales in the apical cilia; discal cell of the underside of wings densely clothed with dark fuscous scales

in both sexes, except in very pale specimens. Hind wings pale ocherous, cilia darker, reddish tinged. Legs whitish ocherous, posterior femora densely fuscous dusted. Abdomen whitish ocherous above, more or less fuscous dusted beneath.

Alar expanse 8 to 9 mm.

Male genitalia (figs. 69, 69a). Vinculum angled (a right angle), produced (saccus), saccus enlarged at tip; free arms of costa of harpe much produced beyond junction with transtilla and connected with the flattened area of harpe by a thin membrane, setae of harpe spine-like; anellus nearly globular, microscopically spined, ventral margin with a deep, narrow sinus, and fringed with blunt teeth; forks of aedeagus nearly as long as stalk, broad, each fork bearing a group of large, blunt, curved teeth; tegumen thick, uncus forks separated by a deep excavation.

Female genitalia (fig. 117). Margins of ovipositor lobes oblique, peg setae small and closely placed, lateral lobes very small; sex opening in an elongate sinus; enlarged portion of ductus bursae with sinuate irregular thickenings; posterior apophyses enlarged at tips, shorter than the slender anterior apophyses; sclerotized portion of segment 8 reduced midventrally, expanding anteriorly to the broad arms of patibulum; prela slender.

Type. — ♂, Pine, Gila County, Arizona, reared on *Quercus arizonica* Sarg., larva VI.4.68, imago emerged VIII.15.68 (P. A. Opler, J. Powell No. 68F38) [UCB].

Allotype — ♀, Pine, Gila County, Arizona, reared on *Quercus arizonica,* larva VI.4.68, imago IX.19.68 (P. A. Opler, J. Powell No. 68F38) [UCB].

Paratypes. — 2 ♂, 2 ♀, same data as the type and allotype, except dates of emergence from VIII.7.68 to IX.19.68 [UCB]; 1 ♀, Oak Creek Canyon, Coconino County, reared on *Q. arizonica,* larva VI.4.68, imago VIII.30.68 (P. A. Opler, J. Powell No. 68F28) [UCB]; 2 ♀, 1 ♂ (without head), Madera Canyon, Santa Rita Mts., Arizona, reared on *Q. reticulata,* larva VI.6.68, imagoes VII.22 (♂), VII.25 and VIII.2.68 (♀'s) (P. A. Opler, J. Powell No. 68F56) [UCB].

The two female paratypes from Madera Canyon lack the black-tipped scales in the tornal spot and in apex of wing, the male paratype shows apical dark dusting but the tornal spot is scarcely differentiated.

The larvae are miners in leaves of *Quercus arizonica* Sarg. and *Quercus reticulata* Humb. & Bonpl. The figures, 37 and 37a, illustrate mines on *Q. arizonica.* In the completed mine at time of pupation (fig. 37), the loosened epidermis is drawn into many fine wrinkles or ridges; these fan out and extend to the upper and lower margins of the longitudinally placed mine, which may span the midrib; each ends at the edge of the raised epidermis as a sharp elevated ridge. A younger mine (fig. 37a) exhibits the same character-

istic ridges. At pupation, the leaf is rolled.

The characteristic mine, differing from mines of all other oak-feeders, will identify this species in the early stages. The genitalia of both sexes, especially the unique character of the male genitalia, separate *T. arizonica* from all other described species.

(13) Tischeria clemensella Chambers (Figs. 10, 38, 70, 70a, 118.)

1878. *Tischeria clemensella* Chambers, Bull. U. S. Geol. and Geogr. Surv. of Terr. IV: 98-99. Type ♂ (hind wing only), Kentucky [MCZ].
1875. *Tischeria zelleriella* Chambers (not Clemens), Cin. Quart. Journ. Sci. II: 110.
1891. *Tischeria clemensella* Walsingham, Ins. Life III: 388.
1923 (1924). *Tischeria clemensella* Braun, Trans. Am. Ent. Soc. XLIX: 356.
1878. *Tischeria bicolor* Frey and Boll, Stett. Ent. Zeit. XXXIX: 255. Type ♀, Dallas, Texas [BM].
1891. *Tischeria bicolor* Walsingham, Ins. Life III: 388.

Face white, forward projecting scales of tuft whitish, scape of antenna whitish, shaft shaded with fuscous, crown pale ocherous. Fore wings faintly shining, variable in color, pale ocherous to brownish ocherous, middle of costa sometimes darkened; apical third of wing from costa to tornus dusted with dark brown-tipped scales, the dusting more conspicuous on paler wings, less conspicuous on darker wings, where the dark dusting scarcely contrasts and the wing appears almost unicolorous, but somewhat darker toward apex; cilia fuscous-tinged from apex to tornus. Hind wings whitish ocherous to pale ocherous; in the male as wide as the fore wings in the basal half (fig. 10, ♂), then abruptly tapering to the acute apex; in the female wide, but narrower than in the male and gradually tapering to the acute apex (fig. 10 ♀); in the broad basal half of the wing of the male, the costal half on the upper side is densely clothed with scales; cilia pale brownish ocherous. Legs ocherous. Abdomen ocherous above, densely dusted with fuscous beneath.

Alar expanse 6.6 to 7.4; a Texas ♂ specimen 8 mm.

Male genitalia (figs. 70, 70a). Vinculum pointed, strong sclerotization subtending the angle; setae of harpe moderate in length; anellus a broad cylinder; stalk of aedeagus long and slender, forks rounded at apex, with a series of minute wrinkles; sclerotized band between forks of uncus crescent-shaped.

Female genitalia (fig. 118). Ovipositor lobes much larger then lateral lobes, peg setae narrow, not dense, heavy setae of lateral lobes long, equaling peg setae in width; posterior and lateral margins of sex opening sclerotized; posterior apophyses exceeding anterior apophyses, enlarged at tips; sternite of segment 8 reduced, arms of patibulum slender, gradually increasing in breadth; prela very large in basal half, abruptly tapering.

Specimens examined. — 11 ♂, 3 ♀.

KENTUCKY: ♂ type (hind wing only) [MCZ]; Upton, Larue County, 1 ♀, rearing record B.1616, on *Quercus marilandica* Muenchh., imago, VII.8.38 [AFB].

OHIO: Cincinnati, 1 ♂, rearing record B.1074, on *Quercus palustris* Muenchh., imago VIII.29.21, 1 ♀, "oak", imago V.16.19, 1 ♂, rearing record B.2470, on *Q. palustris,* imago IV.20.68 [AFB].

ARKANSAS: Devil's Den State Park, Washington County, 1 ♂, 1 ♀, V.20, V.24.66, 5 ♂, July 8 to July 20, 1966 (R. W. Hodges) [USNM].

TEXAS: 1 ♂, "793", "from Boll, Texas", labeled by Boll "*Tischeria zelleriella* Clem." [USNM]; 1 ♂, "792", "From Boll, Texas, Collection C. V. Riley", labeled by Walsingham (Aug. 91) "*Tischeria bicolor* F. & B. (♂, worn)" [USNM].

The larvae mine leaves of several species of oak, including *Quercus palustris* Muenchh., *Q. marilandica* Muenchh., and *Q. macrocarpa* Michx. The mine lies along the margin of the leaf, and at maturity the leaf is rolled, partially concealing the mine (fig. 38); more elongate mines (e.g. the mine on *Q. marilandica,* may resemble those of *T. citrinipennella.* Frey records the mine on *Quercus obtusiloba* (= *macrocarpa*). Chambers (1875) also records it on "*Quercus obtusiloba.*" Later (1878), he states that "it is placed indifferently at any part of the upper surface." I question this statement.

The wide hind wings, abruptly tapering in the male, separate this species from all others of our fauna.

(14) Tischeria fuscomarginella Chambers (Figs. 39, 71, 71a, 120.)

1875. *Tischeria fuscomarginella* Chambers, Cin. Quart. Journ. Sci. II: 110. Type ♂, Kentucky [MCZ].

1890. *Tischeria fuscomarginella* Walsingham (not Chambers), Ins. Life II: 324. Misidentification.

1891. *Tischeria fuscomarginella* Walsingham, Ins. Life III: 388.

Face white, forward projecting scales of tuft and antennal scape white, crown whitish to ocherous. Fore wings reddish ocherous (typically), sometimes paler, the costal margin, apical fourth of wing, and outer half of dorsal margin reddish fuscous, the scales in the apical fourth perceptibly dark-tipped; in the outer half of the costal margin where the line of dark scales widens, there is, in dark specimens, a perceptible purplish tinge; cilia reddish ocherous, reddish fuscous in dark specimens, paler toward tornus only in pale specimens. Hind wings very narrow, pale ocherous, usually with a reddish tinge, cilia reddish ocherous. Legs pale ocherous, posterior

tarsi fuscous shaded. Abdomen pale ocherous, fuscous dusted beneath and sometimes above.

Alar expanse 6.5 to 7 mm.

Male genitalia (figs. 71, 71a). Vinculum not produced, nearly right-angled; apex of costa of harpe acute, setae long; anellus rounded conical, minutely spined; forks of aedeagus very narrow; forks of uncus widely separated, acuminate. Dorsal margin of segment 8 fringed with very long setae.

Female genitalia (fig. 120). Ovipositor lobes much larger than the very small lateral lobes, densely clothed with small peg setae; sex opening circular, with lateral sclerotized projections, enlarged portion of ductus bursae not spined, constriction beyond minutely spined, bursa copulatrix minutely tuberculate; posterior apophyses gradually widening to tip; segment 8 not reduced, broad posteriorly, arms of patibulum diverging from segment 8 near the median line, articulating in a swollen area of the anterior apophyses; prela small, short.

Specimens examined. — 10 ♂, 5 ♀.

KENTUCKY: ♂ type [MCZ]; Carter Caves State Park, 1 ♂, V.10.41; Natural Arch, McCreary County, 1 ♀, reared on *Quercus prinus* L. (*montana*), larva VI.22.32, emergence of imago VII.28.32; Cumberland Falls State Park, 1 ♂, "on oak", imago VII.8.36 [AFB].

OHIO: Cincinnati, 2 ♂, rearing record B.2426, on *Quercus muehlenbergii* Engelm., imagoes IV.10 and IV.14.1966 [AFB]; Roosevelt Lake, Scioto County, 1 ♀, rearing record B.2349, on *Castanea dentata* (Marsh.) Borkh., imago VII.18.1963 [AFB].

VIRGINIA: Falls Church, 1 ♀, on *Castanea dentata*, iss. Aug.3.13, accompanied by mine [USNM].

NEW JERSEY: 1 ♂, labeled K155 (W. D. Kearfott) [AFB].

NEW YORK: Six Mile Creek, Ithaca, 2 ♂, 2 ♀, V.21, V.26, 1959 (R. W. Hodges) [USNM].

MASSACHUSETTS: Martha's Vineyard, 2 ♂, VIII.14 (F. M. Jones) [USNM].

Chambers (1875) in describing this species writes "The larva mines the leaves of white oak (*Quercus alba*) on the *under* surface, at the edge, the leaf being curled *downward,* around the mine" . . . . "The fuscous margins of the fore wing and the character of its mine distinguish it from other known species." I have never seen an underside *Tischeria* mine on oak leaves; the specimen from an underside mine on white oak, recorded by Darlington, is without question *T. badiiella.*

The specimen, K155, agrees exactly with Chambers' type in the Museum of Comparative Zoology. I have identified as *T. fuscomarginella,* specimens agreeing with the type, reared on *Castanea* and

several species of *Quercus*.

The mine (fig. 39) is a gradually widening tract in which all green tissue is consumed and the mine rendered translucent; the frass is retained in the mine and packed in a gradually widening track toward the beginning of the mine (compare with *T. castaneaeella* and *T. zelleriella*), with only a few scattered particles in the outer area of the mine. A thin silken tube leads from the feeding area to the packed frass track. Pupation takes place in an elongate chamber with the upper epidermis drawn into many fine folds, and the leaf but slightly folded; this pupal chamber usually lies over a lateral vein. Mines of all the reared specimens agreee with this description.

The Virginia specimen, although very pale, agrees in genitalia with typical specimens. The four specimens from Ithaca, New York are doubtfully included.

(15) Tischeria castaneaeella Chambers (Figs. 41, 72, 72a, 119.)

1875. *Tischeria castaneaeella* Chambers, Cin. Quart. Journ. Sci. II: 111. Location of type unknown.
1891. *Tischeria castaneaeella* Walsingham, Ins. Life III: 388.
1891. *Tischeria castanella* Walsingham, Ins. Life III: 388.
1927. *Tischeria cinerotunicella* Braun, Trans. Amer. Ent. Soc. LIII: 165. Type ♂, Clermont County, Ohio [AFB]. **(New Synonymy.)**

Face whitish ocherous or pale straw-colored, scales of vertex and crown straw-colored to deep ocherous, projecting forward as a bifurcated tuft (if perfect), scape of antenna straw-colored or ocherous, shaft becoming fuscous toward tip. Thorax concolorous with the head. Fore wings somewhat shining, base concolorous with head and thorax, i.e. whitish to ocherous, sometimes pale lemon yellow, gradually shading to orange yellow, with the tips of the scales in the apex microscopically brownish, but not producing a dusted effect; rarely, the wings of the male shade to a deep reddish brown color in the apex and along the outer half of the costal margin; underside brownish without sex scaling, but surface dusted. Hind wings less than half the width of the fore wings in both sexes except at extreme base, pale gray, darker in dark males, with gray cilia, and minutely dusted in the male, scarcely tinged with gray in pale females, cilia ocherous with a faint reddish tinge; near base, a costal tuft of brown scales. Legs ocherous, shaded with dark brown outwardly. Abdomen above ocherous, with a little dusting on several terminal segments in the male; beneath, densely dusted with brownish fuscous scales, which may spread laterally and densely dust the posterior half of the abdomen above.

Alar expanse 7 to 10 mm.

Male genitalia (figs. 72, 72a). Vinculum with a very short anterior projection; harpe broad, setae moderately long; anellus a broad truncated cone, minutely spinulose in transverse rows, the spinules appearing as fine stippling; forks of aedeagus rounded apically, and toward apex bearing an oblique row of curved sharp teeth; forks of uncus long and acuminate, not widely separated.

Female genitalia (fig. 119). Ovipositor lobes much larger than lateral lobes, peg setae pointed and covering entire surface; lateral lobes with short pointed setae; posterior margin of sex opening strongly sclerotized; posterior apophyses very long and slender, scarcely enlarging at tips; segment 8 not reduced, arms of patibulum broad; prela moderate in size.

Specimens examined. — 14 ♂, 15 ♀.

OHIO: Clermont County, 1 ♂ (type of *cinerotunicella* Braun), 1 ♀ (allotype of *cinerotunicella*), rearing record B.1112, on *Quercus bicolor*, mines collected Sept. 11, 1923, imagoes V.28.24; Brown County, 1 ♂ (paratype of *cinerotunicella*), rearing record B.1112, on *Q. bicolor*, imago IV.25.24, 1 ♂, on *Q. bicolor*, imago V.11.33; Fort Hill, Highland County, 1 ♂, 1 ♀, reared on *Q. prinus*, imagoes IV.30 and IV.26.1960, 1 ♀, B.2372a, on *Q. prinus*, imago VIII.14.64; Beaver Pond, Adams County, 1 ♀, rearing record B.1112, imago V.8.28; Mineral Springs, Adams County, 1 ♂, rearing record B.1323, on *Q. alba*, imago VII.24.1927; Lynx, Adams County, 1 ♀, on *Q. prinus*, larva X.18; Bear Cr. Res., Scioto County, 1 ♀, rearing record B.2377, on *Q. alba*, imago VII.8.64 [AFB].

KENTUCKY: Morehead, Rowan County, 1 ♂, 1 ♀, on *Q. prinus*, imagoes IV.20 and III.31.1938; Fox Mountain, Fleming County, 1 ♂, on *Q. alba*, imago V.27.1938; Carter Caves State Park, Carter County, 1 ♀, on *Q. marilandica*, imago IV.20.1933; Natural Bridge State Park, Powell County, 1 ♀, on *Q. coccinea*, imago III.29.1944 [AFB].

ILLINOIS: Putnam County, 1 ♂, "bred on *Quercus alba*," imago March 29, 1939 (M. O. Glenn) [USNM]. Genitalia slide 3083, J. F. G. C. [USNM].

NEW JERSEY: New Lisbon and vicinity, 1 ♂, "leaf miner on upperside White Oak, white blotch mine,", emerged June 1, 1936, 1 ♀, "leaf miner on white oak, emerged May 25, 1936, 1 ♀, "leaf miner on black oak, upper side," emerged June 2, 1940, 1 ♂, "leaf miner on Willow Oak, upper side," "feces in compact mass at one place in mine," emerged May 29, 1940 [Darlington Collection, ANSP].

VIRGINIA: Falls Church, 1 ♀, *"Quercus rubra"*, with mine, "Apr. 6-14" (C. Heinrich); 3 ♂, 3 ♀, "*Quercus velutina*, black oak", several May dates of emergence [USNM].

FLORIDA: Orlando, 1 ♂, "at light, 2-18" (G. G. Ainslie) [USNM].

The larvae of *T. castaneaeella* are miners in leaves of a number of species of *Quercus*, including *Q. bicolor* Willd., *Q. alba* L., *Q.*

prinus L., *Q. marilandica* Muenchh., *Q. phellos* L., *Q. rubra* L., *Q. coccinea* Muenchh., and *Q. velutina* Lam. The mine (fig. 41) is characterized by the concentric crescents on the loosened upper epidermis, and the multitude of very fine wrinkles over the pupal chamber; all frass is retained within the mine. The mine begins as a linear tract, gradually enlarging, somewhat trumpet-shaped, and toward the end of the feeding period, broadening out. On most species of oaks, the mine is gray, with frass packed toward the beginning of the mine; the expanded portion of the mine is paler, but still grayish, and the concentric markings are conspicuous. Pupation takes place in an elongate oval silken-lined chamber, with the upper epidermis above it so finely wrinkled as scarcely to show the individual folds.

Tischeria castaneaeella is best recognized in the mining stage. The fore wings of the imagoes are extremely variable, small males indistinguishable from *T. fuscomarginella*; such specimens may, however, be separated from that species by the gray and somewhat wider hind wings. The teeth on the forks of the aedeagus are similar to those on the aedeagus of the following species, but the apices of the forks are quadrate, not rounded. The Florida male agrees in genitalia with *T. castaneaeella* (Slide 924, AFB).

(16) Tischeria perplexa new species (Figs. 73, 73a, 122.)

Face white, tuft and antennae whitish ocherous. Fore wings pale ocherous, with indistinct and scarcely perceptible darker orange-tinged longitudinal streaks; one such streak follows the costal margin, a second lies below the margin, a third along the fold, a slight darkening along dorsum; these markings are not sharply defined, but are most distinct in the female allotype; they unite in the apical third of the wing, with the orange tinge predominating and deepening to brownish orange at apex; costal and apical cilia brownish orange, cilia paler toward tornus. Hind wings very narrow in male, whitish, wider in female, tinged with fuscous. Legs whitish ocherous. Abdomen whitish ocherous, without dark dusting (♂ paratype).

Alar expanse 7 to 8 mm.

Male genitalia (figs. 73, 73a). Vinculum very obtusely angled, angle thickened; harpe broad, exceeding forks of uncus, densely setose, setae moderately long; anellus cylindrical, densely clothed with rounded spinules (only visible under high power); stalk of aedeagus long, forks broad, abruptly expanding to a right angle, truncate at apex, midway bearing a row of curved teeth, sinus between the forks above the middle; forks of uncus short, narrowing to rounded apices.

Female genitalia (fig. 122). Ovipositor lobes much larger than the lateral lobes, peg setae small, truncate at tips; sex opening sclerotized posteriorly; posterior apophyses slender, somewhat enlarged at tips; segment 8 not reduced, arms of patibulum broad, abruptly narrowing, articulating with the anterior apophyses near their tips; prela moderate in size, outer half curved.

Type. — ♂, Falls Church, Virginia, "on chestnut, iss. June 25, 1913, Hopkins 11154, reared C. H. Heinrich" [USNM, Type No. 71292]. Right fore wing missing.

Allotype. — ♀, Falls Church, Va., "on chestnut, iss. June 26, 1913, Hopkins 11154, reared C. H. Heinrich" [USNM].

Paratypes. — 1 ♂, Falls Church, Va., "on chestnut, iss. Aug. 6, 1913, Hopkins 11154a, reared C. H. Heinrich"; 1 ♀ (without abdomen), same data as the type, except date of emergence June 28 [USNM].

No mines accompany these four specimens and it is therefore not possible to determine whether the frass is retained as in the closely related *T. castaneaeella.*

The less uniform coloring and the streaking of the fore wings separate *T. perplexa* from *T. castaneaeella.* The female genitalia are very similar in the two species. The male genitalia of *T. perplexa* are characterized by the elongate cylindrical anellus, with microscopic rounded spinules, and the broad forks of aedeagus.

(17) Tischeria sulphurea Frey and Boll (Figs. 5, 75, 75a.)

1878. *Tischeria sulphurea* Frey and Boll, Stett. Ent. Zeit. XXXIX: 256. Type ♂, Texas [BM].

1891. *Tischeria sulphurea* Walsingham, Ins. Life III: 387.

Face pale ocherous, scales of tuft darker ocherous, usually darker than the fore wings except at apex; scape of antenna somewhat paler, shaft grayish ocherous, with narrow darker annulations. Thorax and fore wings pale lustrous yellowish ocherous, scarcely darker in the apex, but the scales are here minutely dark-tipped; cilia concolorous; in the male, on the underside a thick mat of closely appressed grayish brown scales along the discal cell. Hind wings of the male as wide as the fore wings, evenly lanceolate, both margins convex; on costa near base are short, almost scale-like dark brownish fuscous cilia, followed by short, but slightly longer, brownish fuscous cilia to about three-fourths the wing length, where the cilia are abruptly long (fig. 5); the long cilia are yellowish, slightly reddish tinged at apex, and darker than the pale lustrous wings. Legs pale. Abdomen grayish yellow above, pale beneath.

Alar expanse 8 to 8.5 mm.

Male genitalia (figs. 75, 75a). Vinculum shortly produced; harpe

broad, cilia moderately long; anellus a broad cylinder, beset with acute, short, tooth-like spines, largest around orifice, becoming progressively smaller proximad, toward base unarmed; stalk of aedeagus scarcely longer than the forks, forks broad, rounded at tips, and bearing above middle, a single, strongly sclerotized sharp tooth; forks of uncus curved and acuminate (viewed laterally).

Female unknown.

Specimens examined. — 4 ♂.

DISTRICT of COLUMBIA: 2 ♂, "8891, Coptotriche on oak, D.C., iss. July 24, 1902" (A. Busck) [USNM].

NEW JERSEY: Lakehurst, 1 ♂, 3 May, 1962 (R. W. Hodges) [USNM].

FLORIDA: Orlando, 1 ♂, "at light, 2-16-18" (G. G. Ainslie) [USNM]. 1 ♂, in poor condition, doubtfully referred to this species, "Siesta Key, Sarasota Co., Fla. March 27, 1954, C. P. Kimball."

Busck's reared series, 8891, includes three different species. Besides the two male *T. sulphurea,* examples of *T. zelleriella* and *T. badiiella* were reared, but the mines were not discriminated between. Accompanying these specimens are several mines; one of these lies along the margin of a leaf, the frass is retained in the mine, which is drawn into several prominent wrinkles and the leaf rolled; this mine may be a mine of *T. sulphurea.* It is only by rearing both sexes together, with careful description of the mines, that the female can be identified.

Walsingham's characterization of the species from an examination of the type (1891) enabled the certain identification of the specimens herein described. The mat of scales on the underside of the fore wing is easily lost by pressure while spreading.

The lustrous fore wings — more lustrous than those of any other species — are a noteworthy feature. The near relationship to *T. zelleriella* is shown by the characters of the genitalia, especially the single sharp tooth on each fork of aedeagus.

(18) Tischeria zelleriella Clemens

(Figs. 6, 6a, 24, 40, 74, 74a, 123.)

1859. *Tischeria zelleriella* Clemens, Proc. Acad. Nat. Sci. Phila., p. 326. Type, right fore wing only, Easton, Pennsylvania [ANSP, Type No. 7538].
1871. *Tischeria zelleriella* Chambers, Can. Ent. III: 208.
1872. *Tischeria zelleriella* Stainton, Tin. No. Am., p. 81.
1873. *Tischeria zelleriella* Frey and Boll, Stett. Ent. Zeit. XXXIV: 220.
1875. *Tischeria zelleriella* Chambers, Cin. Quart. Journ. Sci. II: 109.

1875. *Tischeria zelleriella* Zeller, Verh. zool.-bot. Ges. Wien. XXV: 352.
1878. *Tischeria zelleriella* Chambers, Bull. Geol. and Geogr. Surv. Terr. IV: 98.
1891. *Coptotriche zelleriella* Walsingham, Ins. Life III: 386.
1903. *Tisheria zelleriella* Busck, Proc. Ent. Soc. Wash. V: 191.
1923. *Tischeria zelleriella* Forbes, Mem. 68, Cornell Univ. Agric. Exp. Sta., p. 148.
1873. *Tischeria complanoides* Frey and Boll, Stett. Ent. Zeit. XXXIV: 220. Type ♀, Texas [BM].
1878. *Tischeria complanoides* Chambers, Bull. Geol. and Geogr. Surv. Terr. IV: 99.
1890. *Coptotriche complanoides* Walsingham, Ins. Life II: 322.
1878. *Tischeria latipennella* Chambers, Bull. Geol. and Geogr. Surv. Terr. IV: 97. Type ♂, Texas.
1891. *Tischeria latipennella* Walsingham, Ins. Life III: 387.

Face whitish ocherous, scales of vertex and crown varying from whitish ocherous to brownish ocherous, projecting forward as a bifurcated tuft; antennal scape usually paler than the crown, shaft pale ocherous, faintly annulate. Fore wings somewhat shining, especially in males, pale ocherous to reddish or brownish ocherous, shading to reddish or brownish ocherous at apex, apical area not contrasting in the darkest specimens; cilia concolorous around apex, pale ocherous toward tornus; on the underside of the wing a narrow fold along costa to three-fourths (fig. 6), entire discal area in the male clothed with long hair-scales directed outwardly and projecting beyond cell, in the female without specialized scales. Hind wings of male whitish ocherous, distinctly yellower at apex, cilia ocherous, often fuscous-tinged, as wide as the fore wings, costal margin abruptly bent downward at three-fourths and joining the dorsal margin at an acute angle (fig. 6), costal cilia long from base to bend of costa, thence to apex very short, dorsal cilia long; hind wings of female pale grayish fuscous to dark gray, cilia in general concolorous with the wing, but often reddish tinged, two-thirds the width of the fore wings (fig. 6a). Legs whitish ocherous, densely dusted with dark fuscous on hind tibiae and tarsi. Abdomen yellowish, densely dusted above with fuscous scales, especially the terminal segments.

Alar expanse 7.5 to 9.5 mm.

Male genitalia (figs. 74, 74a). Vinculum acutely angled and produced; harpe clothed with very long and slender setae; anellus (fig. 74a) cylindrical and clothed toward orifice with short, acute spinules; stalk of aedeagus longer than the forks, each fork bearing above middle a single strongly sclerotized sharp tooth; forks of uncus strongly sclerotized, curved, widely separated at base by heavy sclerotization.

Female genitalia (fig. 123). Ovipositor lobes greatly exceeding the very small lateral lobes, peg setae well separated; margins of sex opening laterally produced; posterior apophyses long, slender, abruptly enlarged at

tips; segment 8 not strongly sclerotized anteriorly, arms of patibulum thus separated anteriorly, slender except at origin; prela large, slender tips outwardly curved.

Specimens examined. — 51 ♂, 44 ♀.

ONTARIO: Ottawa, 1 ♀, Quercus alba, 57-213, 11.III.58; Kinburn, 1 ♂, 1 ♀, Quercus alba, 4.III, 5.III; Simcoe, 2 ♀, Quercus alba, 17.III.1960, 17.V.1965; Normandale, 2 ♂, 1 ♀, Quercus borealis, 28.V to 31.V.1962; Pt. Pelee, 1 ♂, 2 ♀, 27.IV to 29.IV.1964 [CNC].

QUEBEC: Hull, 3 ♂, 3 ♀, Quercus alba, 10.III to 18.III.1957 [CNC].

MASSACHUSETTS: Martha's Vineyard, 1 ♂ [USNM].

NEW YORK: Collection Beutenmueller 2 ♂, 1 ♀ [USNM]; Ithaca, 1 ♀, (R. W. Hodges) [USNM].

NEW JERSEY: 1 ♂, "New Lisbon, N.J. June 13, 1933" "Leaf miner on oak", mine with specimen [Darlington Collection, ANSP]; Caldwell, 1 ♂ [USNM]; Essex Co., 1 ♀ [USNM]; Anglesea 1 ♀ [USNM].

DISTRICT of COLUMBIA: 1 ♂, "8891, Coptotriche on oak, D.C. iss. April 17, 1900" (A. Busck) [USNM].

VIRGINIA: Falls Church, 1 (sex not determined) [USNM].

NORTH CAROLINA: Asheville, 1 ♀, "oak, i. VIII.2" [USNM].

WEST VIRGINIA: Cooper's Rock State Park, 1 ♀, rearing record B.1675, on *Quercus prinus* L., imago March 24, 1939 [AFB].

KENTUCKY: Olive Hill, Carter County, 1 ♀, "red oak", imago V.4.33; Morehead, Rowan County, 1 ♀, "on *Q. alba*", imago IV.27.38; McCreary County, 2 ♂, 1 ♀, on *Q. prinus*, imagoes IV.15.1942; Mammoth Cave National Park, 1 ♀, rearing record B.2444, on *Q. borealis maxima* Marsh., imago IV.13.67 [AFB].

OHIO: Cincinnati, 2 ♂, 3 ♀, rearing record B.202, on *Q. bicolor* Willd., imagoes April 25 to May 18, 2 ♂, 1 ♀, "oak"; Clermont County, 1 ♂ (flown), 1 ♂ "chestnut"; Clinton County, 2 ♂, 2 ♀, rearing record B.1105, on *Q. bicolor*, imagoes May and August; Highland County, Fort Hill State Memorial, 1 ♂, B.2372, on *Q. borealis maxima*, imago VII.14.64; Adams County, Beaver Pond, 3 ♂, 2 ♀, rearing record B.1338, on *Q. stellata* Wang., imagoes May 1-6, 1928, Oliver Township, 1 ♀, rearing record B.2471, on *Q. stellata*, imago VIII.13.68, 1 ♀, rearing record B.2464, on *Q. alba*, imago IV.21.68; Buzzardroost Rock, 1 ♂, imago IV.27.1930 [AFB].

ILLINOIS: Putnam County, 1 ♂, 1 ♀, "reared ex oak leaf" (M. O. Glenn) [USNM].

MISSOURI: 3 ♀ (Riley Coll.); 2 ♂, 1 ♀, "from Murtfeldt" [USNM].

ARKANSAS: Devil's Den State Park, Washington County, 21 ♂, 8 ♀, May, June, and July dates [USNM].

In addition to the above localities, *T. zelleriella* has been recorded from Texas (type locality of *T. complanoides* Frey and Boll).

The larvae are miners in leaves of chestnut and several species of oak, including *Quercus alba* L., *Q. bicolor* Willd., *Q. stellata*

Wang., *Q. prinus* L. (*Q. montana* Willd.), *Q. rubra* L. (*Q. borealis maxima* Marsh.). Larva (fig. 24) typical of the genus, but head larger in proportion to thoracic segments than in other species. The mine (fig. 40), at first somewhat trumpet-shaped, spreads out irregularly; all frass is retained in the mine, the pellets aggregated in patches and more densely packed toward the beginning of the mine. At pupation, the loosened epidermis is drawn into several folds, and there torn at each end, and the pupal chamber thus formed lined with silk.

The pupa is figured by Mosher (1916); it is typical of the oak-feeding species of the genus.

Although Clemens failed to note the width of the hind wing of the male, his description of the fore wing of the type and of the female, agrees with our concept of the species. Apparently several species were reared together; the description of the mine fits *badiiella* rather than *zelleriella.*

(19) Tischeria quercitella Clemens (Figs. 9, 25, 42, 76, 76a, 121.)

1863. *Tischeria quercitella* Clemens, Proc. Ent. Soc. Phila. II: 13. Type, Easton, Pennsylvania [ANSP, Type No. 7536].
1871. *Tischeria quercitella* Chambers, Can. Ent. III: 208.
1872. *Tischeria quercitella* Stainton, Tin. No. Am., p. 221.
1875. *Tischeria quercitella* Chambers, Cin. Quart. Journ. Sci. II: 111.
1875. *Tischeria quercitella* Zeller, Verh. zool.-bot. Ges. Wien XXV: 352.
1878. *Tischeria quercitella* Chambers, Bull. Geol. and Geogr. Surv. Terr. IV: 97.
1880. *Tischeria quercitella* Chambers, Psyche III: 68.
1903. *Tisheria quercitella* Busck, Proc. Ent. Soc. Wash. V: 191, 212.
1875. *Tischeria tinctoriella* Chambers, Cin. Quart. Journ. Sci. II: 108. **(New Synonymy.)**
1882. *Tischeria tinctoriella* Walsingham, Trans. Amer. Ent. Soc. X: 202.
1890. *Tischeria tinctoriella* Walsingham, Ins. Life II: 324.
1891. *Tischeria tinctoriella* Walsingham, Ins. Life III: 388.
1903. *Tisheria tinctoriella* Busck, Proc. Ent. Soc. Wash. V: 191, 212.
1924. *Tischeria tinctoriella* Braun, Trans. Amer. Ent. Soc. XLIX: 356.

Face ocherous, tuft brownish ocherous, scape of antenna brownish ocherous, shaft ocherous, darker toward tip. Fore wings orange-ocherous, the scales of the entire wing surface tipped with brown, producing a finely dusted aspect; darker along costa, especially in the outer half; scales in the apical area more conspicuously dark-tipped and appearing coarser; at tornus, a dark brown or blackish patch, very rarely obsolescent; cilia fuscous. Hind

wings and cilia fuscous, with faint reddish tinge. Legs pale brownish ocherous, spurs of hind tibiae brown. Abdomen pale ocherous, more or less dusted.

Alar expanse 7 to 7.5 mm, occasionally less.

Male genitalia (figs. 76, 76a). Vinculum triangular, blunt anteriorly; harpes with ventral margins angled, bases of sacculi thickly sclerotized and fused together, near the base a setose elongate lobe, cucullus defined, elongate; transtilla absent; anellus a curved plate, bifurcate toward tip, two curved short pointed prongs at base bordering a semicircular orifice; stalk of aedeagus short, slightly expanded at base, forks long, narrowing to the linear acute tips; forks of uncus elongate, erect, setose, separated from tegumen by a sclerotized band.

Female genitalia (fig. 121). Ovipositor lobes large, rounded, and clothed with short, very slender peg setae; lateral lobes very small, setae long; posterior apophyses slender, tapering to acute tips; sternite of 8 heavily sclerotized, emitting at its posterior median margin a sharp thorn-like process, the arms of patibulum short, arising laterally; prela long, slender, tapering to acute curved apices; enlarged portion of ductus bursae with two broad bands of microscopic spinules.

Specimens examined. — 32 ♂, 21 ♀, 24, sex not determined.

ONTARIO: Port Colborne, 1 specimen with mine [CNC].

MASSACHUSETTS: Martha's Vineyard, 1 ♀, VI.19, (F. M. Jones) [USNM].

NEW JERSEY: "emerged New Lisbon," 13, ♂, ♀, May 31 to June 14, 9, ♂, ♀, July 31 to Aug. 19; "leaf miner" on several species of oak, including white oak, "chest. oak", scrub oak; accompanied by mines, conspicuously marked with purple lines [Darlington Collection, ANSP]; Essex County Park, 1 ♂, 5.13.1900 [USNM].

DISTRICT of COLUMBIA: 4 ♂, 3 ♀, "A.B.3 on oak", emergence April 20 to May 1 (A. Busck) [USNM]; 2 ♂, "8803, on oak, iss. July 25, 99" [USNM].

VIRGINIA: Falls Church, 7 ♂, 7 ♀, "reared Quercus prinus", emergence April, 1914 (C. Heinrich) [USNM]; 2 ♀, "reared *Castanea dentata*", emergence April, 1914 (C. Heinrich) [USNM].

PENNSYLVANIA: Easton, type [ANSP].

OHIO: Cincinnati, 9 ♂, 5 ♀, reared on *Quercus alba,* emergence, April 26 to May 30, July 21 to Aug. 14 [AFB]; 1 ♀, on *Castanea,* imago VIII.14.07 [AFB]; 2 ♂, 2 ♀, Apr. 13, June 3, June 17, July 25, "on oak" [USNM].

KENTUCKY: Lewis County, 1 ♂, "on *Q. alba,* i. VIII.9.31" [AFB]; Powell County, 1 ♂, "chestnut, i. VII.25.16" [AFB].

ILLINOIS: Putnam County, 1 ♂, "ex oak leaf" Feb. 25, 1929 (M. O. Glenn) [USNM].

MISSOURI: "C.Mo. 3/10.88", 2 ♂, (Riley Collection) [USNM]; 2 ♂, "From Murtfeldt" [USNM].

The larvae are miners in leaves of several species of oak, most

commonly *Quercus alba* L., also *Q. prinus* L., *Q. velutina* Lam., and *Q. ilicifolia* Wang.; occasionally on *Castanea dentata* (Marsh.) Borkh.

The mine (fig. 42) is characterized by the circular slightly raised nidus, and the radiating dark purplish lines; the loosened epidermis is at no time wrinkled. The mine begins with the typical minute translucent area, which later may be seen at the edge of the nidus. The circular nidus to which the larva retreats when alarmed or not feeding, and within which pupation takes place, is densely lined with silk; the blotch mine enlarges irregularly, however not obliterating the translucent area, adjacent to which is the circular hole for ejection of frass. At emergence, the pupa is thrust through the loosened epidermis at the edge of the nidus near the beginning of the mine. The larva (fig. 25) is much flattened, more so than in the typical members of the oak-mining species, a character possibly correlated with the flat mine; the head is triangular, with mouth-parts projecting, and the body segments projecting laterally well beyond the intersegmental membrane.

In the pupa, the lateral setae are short, not forked at tips, and the anal area is devoid of setae, and the paired dorsal setae are very short, in these characters differing from the typical oak-mining species and agreeing with the Composite feeders.

The venation of the fore wing (fig. 9) also agrees with the venation of the Composite feeders in that Cu is abruptly bent down at the end of the cell and extends to wing margin as a short spur.

The unique male genitalia set *T. quercitella* apart from all other North American species except the Mexican *T. elongata* Walsingham. These two species might perhaps be considered as constituting a separate section.

As *T. quercitella* is the only known American species among the oak miners which spins the circular nidus, there should be no confusion in identifying reared specimens. Frey (1873, 1878) incorrectly referred specimens of *T. citrinipennella* to *quercitella*. The mine of the European *T. decidua* Wck. has a similar nidus.

(20) Tischeria elongata Walsingham (Figs. 77, 77a.)

1914. *Tischeria elongata* Walsingham, Biologia-Centrali-Americana, IV, Lepidoptera-Heterocera, p. 342. Type ♂, Amula, 6000 ft., Guerrero, Mexico [BM], paratype [USNM].

I quote the original description: —

"*Antennae* and *Palpi* ochreous. *Head* and *Thorax* ochreous; face paler. *Forewings* ochreous, the colour becoming more intense on the outer half; with a few scattered fuscous scales, forming an erect group on the dorsum at two-thirds, and somewhat clouding the apical area and the base of the pale ochreous cilia. Exp. al. 11 mm. *Hindwings* ½, very pale, shining, yellowish grey; cilia very pale ochraceous. *Abdomen* brownish ochraceous. *Legs* pale yellow ochraceous."

"As compared with 6435 citrinipennella Clms., the wings are longer and narrower, and are distinctly peppered with dark dusting, not only at the apex, but towards the base — in this it differs from Clemens' species."

Through the courtesy of the British Museum (Natural History) I have been enabled to examine a photograph of the type. This photograph shows a greater degree of dusting with dark-tipped scales than the description suggests, especially along the dorsum and outer half of costa; the erect group of dark-tipped scales at two-thirds of dorsum is not sharply outlined. The fore wings are noticeably elongate.

The near relationship of *T. elongata* and *T. quercitella* is demonstrated by the very similar and unusual male genitalia of the two species. Furthermore, in general aspect the fore wings of *T. elongata* resemble *T. quercitella.*

The figures of the male genitalia of *T. elongata* (figs. 77, 77a) were drawn by the artist in the Department of Entomology, Smithsonian Institution, from a slide of the holotype, [BM slide No. 15283], prepared at the British Museum by Dr. Don R. Davis.

Section II

Species 21 to 31

The species of this section are miners of leaves of members of the Rosaceae (except No. 27, on *Vaccinium*). Antennae of male with long cilia, of female without cilia or with cilia about one-half the length of those of the male along all or part of the shaft. Fore wings dark gray to brownish or blackish, with more or less bronzy or purplish luster. Figures 13, 14, 15 show variation in venation of fore and hind wings and differences in width of the hind wings. Male genitalia: vinculum usually produced as a slender rod, variable in length; harpe broad, ventral margin evenly rounded or scarcely angled, costa thickened, cucullus rarely differentiated (fig. 86);

anellus usually a simple cylinder, microscopically spinulose, sometimes notched or bilobed ventrally; forks of aedeagus broad, clothed with minute sharp-tipped scale-like cuticular outgrowths (modified spinules), or with a cluster of large, often branched teeth. Female genitalia: ovipositor lobes less densely clothed with peg setae (than in Section I), lateral lobes with long fine setae only; sternite of segment 8 reduced, angled or broadly curved, arms of patibulum slender, arising from the latero-ventral anterior margin; prela usually large.

Only with reared material, accompanied by mines or careful notations on the character of the mine, is it possible to identify the species of this section by superficial examination.

The luster of the fore wings or the brilliancy of the coloring of the fore wings (*admirabilis*) does not develop immediately on emergence and reared specimens should not be killed until some time has elapsed, preferably 12 to 24 hours.

The moths should be spread at the time of emergence, not relaxed and spread later, as moisture may affect the luster.

With age, the fore wings tend to loose their luster and appear grayish. The descriptions and the keys are based on material of relatively recent collecting.

The figures of genitalia in this section are twice the magnification of those in Sections I and III.

Key to the Species of Section II Based on Coloration, Antennae, Food Plants, and Mines

1. Fore wings brilliant golden, bronzy red, and purple, apical half of antennae white; a miner in leaflets of *Rosa* spp. ..... (31) *admirabilis*
   Fore wings not as brilliant, but with bronzy, coppery or purple luster 2
2. Antennae of both sexes ciliate 3
   Antennae of the female not ciliate; a trumpet mine on *Malus* and *Crataegus* ..... (21) *malifoliella*
3. Fine cilia near tip only in female 4
   Antennae of female ciliate throughout 5
4. A narrow mine along margin of leaflet of *Rosa* spp. ..... (23) *roseticola*
   A blotch mine, with loosened epidermis of leaflet in longitudinal folds; on *Rubus* spp. ..... (25) *aenea*
5. Antennae of female with fine short cilia for the entire length 6
   Antennae of female with cilia as long as or longer than the width of a segment, about one-half the length of cilia in male, at least for half the length of the stalk 7

6. A miner on *Rubus vitifolius;* California ..... (26) *splendida*
   A miner in leaves of strawberry; segments of antennae not crowded together toward tip but similar throughout; California .... (29) *inexpectata*
7. Segments of antennal stalk near tip short and appearing crowded; antennae of female thickened toward apex; a miner in leaves of strawberry; California ..... (28) *confusa*
   Segments of antennal stalk near tip of normal length 8
8. Antennae in female thickened with appressed cilia in basal third, distad with cilia one-half the length of those of the male; mine at margin of leaves of *Crataegus* spp. ..... (22) *crataegifoliae*
   Antennae of female not thus thickened 9
9. Entire fore wing with dark purple luster 10
   Fore wing bronzy, shading to lustrous purple toward apex; cilia of antennae of female half the length of cilia of male; a miner in leaves of *Agrimonia* spp. ..... (24) *agrimoniella*
10. Fore wing distinctly irrorate, because of paler bases of scales, cilia paler; cilia of female antennae longer than width of segments; a miner in leaves of *Vaccinium* ..... (27) *insolita*
    Fore wing not irrorate, cilia dark purple from apex to tornus; a miner in leaves of *Amelanchier* ..... (30) *amelanchieris*

Key to the Species of Section II Based on Male Genitalia

1. Forks of aedeagus with clusters of large tooth-like cuticular outgrowths 2
   Forks of aedeagus clothed with minute, acute, scale-like cuticular outgrowths 4
2. Each fork with a double row of acuminate sharp teeth along lower margin of fork, none of teeth forked; vinculum produced into a long rod ..... (30) *amelanchieris*
   Teeth of aedeagus not in a double row; vinculum not produced into a long rod 3
3. Teeth lying along lower margin of fork, and grouped at angle into a projecting tuft; vinculum produced into a short rod .... (29) *inexpectata*
   Teeth larger and grouped into a tuft at angle of fork; vinculum strongly sclerotized and produced into a median posteriorly pointed lobe .... (31) *admirabilis*
4. Vinculum abruptly produced anteriorly into a long slender rod 5
   Vinculum not thus abruptly produced; it may be obtusely angled, or gradually produced to a point 7
5. Forks of aedeagus with a great number of very small densely placed broad scale-like outgrowths 6

Scale-like outgrowths not as numerous and mostly more slender ..... (22) *crataegifoliae*

6. Harpe wide, broadly rounded at apex; a miner of *Agrimonia* spp. ..... (24) *agrimoniella*
   Harpe narrowly rounded at apex; a miner of *Vaccinium* .... (27) *insolita*
7. Vinculum very obtusely angled ..... (25) *aenea*
   Vinculum not obtusely angled 8
8. Vinculum abruptly angled to a point, and not narrowly produced 9
   Vinculum gradually narrowing anteriorly and then produced to a point 10
9. Forks of uncus short and widely separated ..... (28) *confusa*
   Forks of uncus long, and not widely separated ..... (26) *splendida*
10. Vinculum large and broad, and gradually narrowing to a long point; a miner of *Malus* and *Crataegus* ..... (21) *malifoliella*
    Vinculum triangular, anteriorly produced to a point; a miner of *Rosa* .... (23) *roseticola*

Key to the Species of Section II Based on Female Genitalia

1. Posterior apophyses abruptly expanding to foot-shaped tips 2
   Posterior apophyses slender, if enlarged at tips, the tip not foot-shaped 3
2. Ovipositor lobes greatly exceeding lateral lobes in size; prela large, distal half very long and slender ..... (22) *crataegifoliae*
   Ovipositor lobes not greatly exceeding lateral lobes; prela smaller, distal half not very long and slender ..... (30) *amelanchieris*
3. Posterior apophyses slender throughout, not perceptibly enlarged at tips 4
   Posterior apophyses widening near apices to the broadly rounded tips 9
4. Peg setae all curved, prela curving toward tips to the more or less spoon-shaped apices 5
   Peg setae straight (one or more of the lateral anterior ones may curve) 6
5. Peg setae long, hooked at tips; basal half of prela small .. (26) *splendida*
   Peg setae slender, curved, but not hooked; basal half of prela large .... (29) *inexpectata*
6. Ovipositor lobes greatly exceeding lateral lobes, peg setae long and slender; prela small, a sharp tooth at tips ..... (24) *agrimoniella*
   Ovipositor lobes not larger than the lateral lobes 7
7. Ovipositor lobes much smaller than the lateral lobes; prela expanded at tips, toothed ..... (23) *roseticola*
   Ovipositor and lateral lobes subequal 8

8. Posterior margin of sternite of segment 8 rounded ..... (31) *admirabilis*
   Posterior margin of sternite of segment 8 angled ..... (25) *aenea*
9. Peg setae very long, slender and curved; prela slender only in apical third ..... (28) *confusa*
   Peg setae not unusually long 10
10. Prela large, long, becoming slender in apical third ..... (27) *insolita*
    Prela large, broad in basal half, tips triangularly pointed ..... (21) *malifoliella*

(21) Tischeria malifoliella Clemens (Figs. 13, 47, 78, 78a, 124.)

1860. *Tischeria malifoliella* Clemens, Proc. Acad. Nat. Sci. Phila., p. 208. Type, Pennsylvania (probably Easton) [ANSP., Type No. 7537.]
1871. *Tischeria malifoliella* Chambers, Can. Ent. III: 208.
1872. *Tischeria malifoliella* Stainton, Tin. No. Am., p. 141.
1873. *Tischeria malifoliella* Frey and Boll, Stett. Ent. Zeit. XXXIV: 222.
1873. *Tischeria malifoliella* Chambers, Can. Ent. V: 50.
1874. *Tischeria malifoliella* Chambers, Can. Ent. VI: 150.
1875. *Tischeria malifoliella* Chambers, Cin. Quart. Journ. Sci. III: 111.
1878. *Tischeria malifoliella* Frey and Boll (not Clemens), Stett. Ent. Zeit. XXXIX: 254.
1880. *Tischeria malifoliella* Chambers, Psyche III: 68.
1890. *Tischeria malifoliella* Walsingham, Ins. Life II: 326.
1923. *Tischeria malifoliella* Forbes, Mem. 68, Cornell Univ. Agric. Exp. Sta., p. 147.
1952. *Tischeria malifoliella* Darlington (not Clemens), Trans. Am. Ent. Soc. LXXVIII: 56.

Face pale gray, yellowish tinged above; tuft blackish brown, antennae fuscous, shaft not ciliate in female. Fore wings shining dark brown with a faint purplish luster, especially toward apex, and very fine irroration due to the pale extreme bases of the scales, cilia concolorous. Hind wings and cilia gray, reddish tinged especially toward apex; a short line of black scales near base of costa. Legs dark gray, hind tarsi whitish. Abdomen dark gray.

Alar expanse 6 to 6.5 mm.

Male genitalia (figs. 78, 78a). Vinculum gradually narrowing and produced to a long point; harpe broad, densely clothed inwardly with short setae; anellus cylindric; forks of aedeagus clothed with elongate, sharp-pointed cuticular outgrowths; uncus forks widely separated, acute and strongly sclerotized.

Female genitalia (fig. 124). Ovipositor lobes exceeding lateral lobes, clothed with well-separated elongate peg setae; sex opening elliptical; posterior apophyses exceeding anterior apophyses, and somewhat enlarged at tips; prela triangularly pointed at apices.

Specimens examined. — 30 ♂, 26 ♀, 43, sex not determined.

ONTARIO: Normandale, 9 ♂, 8 ♀, "*Malus,* 56-152 and 56-155," July 30 to Aug. 13; Kars, 1 ♂, 2 ♀, "*Malus*", III.3 to III.4; Manotick, 2 ♂, 4 ♀,

"*Crataegus*, 56-226, 8.III to 12.III.1957" (Genitalia slides 925, 926 AFB); Simcoe, 1 ♂, 1 ♀, "*Crataegus*, 59-104", 1 ♀ Aug. 8, 1 ♂ Aug. 17 [CNC].

NEW YORK: Ithaca, 1 ♂, 1 ♀, V.21, V.29 (R. W. Hodges) [USNM].

MASSACHUSETTS: Martha's Vineyard, 1 ♂, "VII.30.Apple" (F. M. Jones) [USNM].

NEW JERSEY: New Lisbon, 37, ♂, ♀, all reared on apple [Darlington Collection, ANSP]; Montclair, 3 ♂, July and September [USNM].

PENNSYLVANIA: Easton, type [ANSP]; Sciota, 1 ♂, "*Malus* sp. 65-31, 27.VII.1965" (Freeman) [CNC]; West Chester, 2 ♀, "*Malus*" (G. G. Lewis) [CNC].

DISTRICT of COLUMBIA: 6, ♂, ♀, reared on apple, several without locality label [USNM].

KENTUCKY: Morehead, 3 ♂, 1 ♀ "*Malus*, 63.F.24", Aug. 16, 1963 [CNC].

OHIO: Cincinnati, 1 ♀, rearing record B.86, on apple, imago VIII.31.07; 1 ♂, 1 ♀, rearing record B.453, on *Crataegus coccinea*, imagoes VII.5, VII.12. 1909; Eastwood, Clermont County, 1 ♀, on *Pyrus coronaria*, imago VII.12.23; Stonelick Lake, Clermont County, 4 ♂, 3 ♀, rearing record B.2330, on apple, imagoes April 2 to 7 [AFB].

INDIANA: Bedford, 2 ♂, 1 ♀, "From *Pyrus malus*", imagoes VIII.19 to VIII.26.1932 (G. Edw. Marshall) [USNM].

TEXAS: 1 ♂, "From Boll."

The larvae are miners in leaves of the cultivated apple, wild crabapple (*Pyrus* spp.) and several species of *Crataegus*. The mine is a typical trumpet mine. In the early part of the mine, the frass is attached to the upper epidermis leaving white arcs of clear epidermis (fig. 47). These white arcs are sometimes obliterated by an extension of the mine over the beginning of the mine (cf. Clemens' description of the mine). Later, the frass is concentrated into a dark mass just beyond the area of the white arcs. Apparently, no frass is ejected, although there is a circular opening which may be closed by silk. Toward completion of the feeding period, the upper epidermis is finely wrinkled over the pupal chamber. The larvae of the fall brood overwinter, changing to pupae in the spring.

At emergence, the pupa is thrust through the upper epidermis. The pupa is figured by Mosher (1916).

It is probable that species of the wild crab, and species of *Crataegus* were the original hosts of *T. malifoliella*. Once considered a pest, with the advent of spraying, it is uncommon in orchards, and is best sought for on isolated trees near former housesites.

The characteristic mine, differing from that of any other species of the genus, will serve for certain identification of the species.

(22) Tischeria crataegifoliae new species (Figs. 43, 79, 79a, 125.)

Face whitish, head lustrous dark bronzy, with faint purplish tinge, antennal shaft slightly serrate toward tip, ciliate in male throughout, in female appearing thickened with very short appressed cilia in basal third, distad with short cilia one-half the length of those in the outer third in the male. Fore wings lustrous dark bronzy, with purplish reflections, more pronounced toward apex. Hind wings gray, cilia gray, concolorous throughout; costa near base with slender projecting black scales. Legs pale gray, hind tarsi white.

Alar expanse 6 to 6.5 mm.

Male genitalia (figs. 79, 79a). Vinculum abruptly produced into a long slender rod; harpe with broadly rounded apex; anellus a broad cylinder; forks of aedeagus densely clothed with pointed scale-like cuticular outgrowths; uncus forks widely separated, less acute than in *malifoliella.*

Female genitalia (fig. 125). Ovipositor lobes greatly exceeding lateral lobes, peg setae long; sex opening rounded, anterior lateral sclerotized margins produced; posterior apophyses abruptly expanded foot-shaped at tips; prela slender in distal half, the tips curving.

Type. — ♂, Pike Lake State Park, Pike County, Ohio, rearing record B.2368, on *Crataegus* sp., imago VI.30.64 [AFB].

Allotype. — ♀, Pike Lake State Park, Pike County, Ohio, rearing record B.2368, on *Crataegus* sp., imago VI.30.64 [AFB].

Paratypes. — 8 ♂, 4 ♀, Pike Lake State Park, Pike County, Ohio, rearing record B.2368, emergence of imagoes June 17 to July 2 [AFB]; 1 ♀, Pike Lake State Park, Pike County, Ohio, rearing record B.2360, on *Crataegus* sp., imago IV.8.64 [AFB]; 1 ♀, Shawnee State Forest, Scioto County, Ohio, rearing record B.2483, on *Crataegus* sp., imago IV.16.69 [AFB]; 2 ♂, 3 ♀, Cincinnati, Ohio, rearing record B.319, on *Crataegus mollis* (T. & G.) Scheele, dates of emergence April (from overwintering pupae), June and early July [AFB]; 2 ♂, 3 ♀, Ottawa, Ontario, on *Crataegus* sp., July 16 to August 15 [CNC]; 2 ♂, 1 ♀, Overbrook, Ontario, "Hawthorn", June 12 to 14 [CNC]; 1 ♀, Simcoe, on *Crataegus*, July 24 [CNC]; 1 ♀, Kimburn, Ontario, on *Crataegus* [CNC]; 1 ♂, 1 ♀, St. Williams, Ontario, on *Crataegus*, imagoes July 23 [CNC]; 2 ♂, Hull, Quebec, "*Crataegus* sp.", imagoes 27 and 29.I.1960 [CNC]; 3 ♂, 1 ♀, West Chester, Pennsylvania, on *Crataegus* [CNC].

The larvae are miners in leaves of a number of species of *Crataegus.* The mine (fig. 43) is always placed at the margin of a leaf. At first the typical minute translucent area is visible, the upper epidermis is then loosened and the mine gradually increased in area, obliterating this early area. The loosened epidermis is brown and in the

earlier feeding period is drawn into fine wrinkles; later, as feeding progresses, the epidermis becomes more wrinkled and at maturity, the leaf curls over and hides all but the outer part of the mine. The mine is a rather evenly outlined blotch. Pupa thrust through the upper epidermis at emergence.

The mines which were collected at Pike Lake were always found on leaves on the lower part of the plant (usually on small plants), within a few feet of the ground. In the latitude of Cincinnati, mines occur in June, with imagoes in later June and early July; a second, the overwintering generation, is full fed in the fall.

Tischeria crataegifoliae is easily separated from *T. malifoliella* by the character of the mine. In genitalia, the long slender rod of vinculum of the male, the foot-shaped expansion of the tips of the posterior apophyses of the female distinguish it from *T. malifoliella.*

(23) **Tischeria roseticola** Frey and Boll (Figs. 45, 80, 80a, 126.)

1873. *Tischeria roseticola* Frey and Boll, Stett. Ent. Zeit. XXXIV: 223. Type Texas (probably Dallas) [BM].
1874. *Tischeria roseticola* Chambers, Cin. Quart. Journ. Sci. I: 210.
1875. *Tischeria roseticola* Chambers, Cin. Quart. Journ. Sci. II: 112.
1890. *Tischeria roseticola* Walsingham, Ins. Life II: 326.

Face yellowish gray, head blackish with slight purplish luster, antennal shaft in male ciliate, in female with fine short cilia near tip only. Fore wings blackish with slight purple reflections, more coarsely scaled in the apical area. Hind wings and cilia dark purplish gray, with projecting black scales near base of costa. Legs dark gray, hind tarsi whitish. Abdomen lustrous purplish black.

Alar expanse 6 to 6.5 mm.

Male genitalia (figs. 80, 80a). Vinculum triangular gradually produced to a point; harpe narrow, inwardly clothed with rather long setae; anellus with shallow sinus; stalk of aedeagus forking well below the tapering blades of the forks, each fork clothed with elongate scale-like outgrowths; forks of uncus not widely separated, very acute.

Female genitalia (fig. 126). Ovipositor lobes much smaller than the large lateral lobes, peg setae slender, some curved; sex opening elliptic; posterior apophyses slender throughout; prela expanded at tips, toothed.

Specimens examined. — 9 ♂, 15 ♀.

OHIO: Miamiville, Clermont County, 6 ♂, 8 ♀, rearing record B.1073, on *Rosa setigera* Michx., mines collected July 22, imagoes August 2, 1921 [AFB]; Clermont County, 2 ♂, 7 ♀, on *Rosa setigera*, imagoes March 22 to April 16, 1924 [AFB]; Steam Furnace, Adams County, 1 ♂, on *Rosa setigera*, imago IV.27.1930 [AFB].

The mines occur commonly on *Rosa setigera* Michx., rarely on other species of *Rosa*. The small elongate mine (fig. 45) lies along the margin of a leaflet; at time of pupation, the loosened epidermis is much wrinkled and the leaf rolled, partially concealing the mine. Frey and Boll record the mine of the type on "Rosa carolina L."

(24) Tischeria agrimoniella new species (Figs. 3, 14, 81, 81a, 127.)

Face white, head dark bronzy, antennal shaft in the male with long cilia, longest near base, in the female with short cilia, half the length of cilia of the male. Fore wings lustrous, dark bronzy near base, shading to dark lustrous purple toward apex. Hind wings very narrow, darker in female and darkest at apex, cilia concolorous; a line of black scales lying along costa near base, only the distal of the series projecting. Legs dark gray, hind tarsi whitish. Abdomen blackish purple.

Alar expanse 6 to 7 mm.

Male genitalia (figs. 81, 81a). Vinculum produced as a slender rod, bending to the right at tip; harpe wide, broadly rounded at apex, obtusely angled on ventral margin, setae rather long; anellus a wide cylinder; stalk of aedeagus very long and slightly swollen at base, forks of aedeagus broad, densely clothed with very small, broad, pointed scale-like cuticular outgrowths, membrane extending beyond the clothed portion; forks of uncus not widely separated, acute.

Female genitalia (fig. 127). Genitalia small; ovipositor lobes greatly exceeding the small lateral lobes, peg setae long and slender; posterior margin of sex opening sclerotized; posterior apophyses slender, scarcely enlarging at tips; anterior apophyses slender; prela small, a sharp tooth at tips.

Type. — ♂, Fort Hill State Memorial, Highland County, Ohio, rearing record B.2373, on *Agrimonia rostellata* Wallr., mine July 8, imago July 23, 1965 [AFB].

Allotype. — ♀, Fort Hill State Memorial, Highland County, Ohio, rearing record B.2373, on *Agrimonia rostellata*, mine July 8, imago July 22 [AFB].

Paratypes. — 1 ♂, 2 ♀, Fort Hill State Memorial, Highland County, rearing record B.2373, imagoes July 10 to July 24; 2 ♂, 2 ♀, Fort Hill State Memorial, B.2373a, on *Agrimonia rostellata*, mines October 5, 1964, imagoes April 4 to April 13, 1965; 2 ♂, Fort Hill State Memorial, rearing record B.2337, on *Agrimonia rostellata*, imagoes March 28, April 2, 1963; 1 ♂, Fort Hill State Memorial, rearing record B.2387a, on *Agrimonia parviflora* Ait., imago September 9, 1966; 1 ♂, Adams Lake, Adams County, Ohio, rearing record B.2476, on *Agrimonia* sp., imago April 17, 1969; 2 ♂, 2 ♀, Shawnee State Forest, Scioto County, Ohio, rearing record B.2365, on *Agrimonia rostellata*, mines June 17, imagoes June 21 to July 2, 1964; 3 ♂, 3 ♀, Cincinnati, Ohio, rearing record B.739, on *Agrimonia* sp., imagoes August 4, 1916; 5 ♂, 1 ♀, Cincinnati, Ohio, rearing record B.2335, on *Agrimonia*

rostellata, imagoes August 9, 1965; 1 ♂, 2 ♀, Daniel Boone National Forest, Wolfe County, Kentucky, rearing record B.2488, on *Agrimonia parviflora*, mines collected October 20, imagoes April 7, April 9, 1970; 2 ♂, 1 ♀, Mammoth Cave National Park, Kentucky, rearing record B.2455, on *Agrimonia rostellata*, imagoes April, 6, 7, 13, 1967 [AFB]; 2 ♂, 1 ♀, Devil's Den State Park, Washington County, Arkansas, June 23, July 3, 1966 (R. W. Hodges); ♂ genitalia slide 939 A.F.B. [USNM].

The larvae are miners in leaflets of *Agrimonia rostellata* Wallr., and *Agrimonia parviflora* Ait. On *Agrimonia rostellata,* the mines are especially common and may occur in great numbers, mines of the preceding generation often present on the same leaves or even the same leaflets with mines containing feeding larvae. The glistening blue iridescent egg may be visible at the beginning of the mine which at first is a narrow elongate tract; as the mine increases in size, the loosened epidermis becomes much wrinkled, and the leaf is curled onto the upper side, nearly concealing the mine; the loosened upper epidermis turns brownish.

Characters of vinculum and aedeagus, and the very small female genitalia separate *T. agrimoniella* from the other species of this section.

(25) Tischeria aenea Frey and Boll (Figs. 20, 46, 82, 82a, 128.)

1873. *Tischeria aenea* Frey and Boll, Stett. Ent. Zeit. XXXIV: 222. Type, Texas (probably Dallas) [BM].
1874. *Tischeria aenea* Chambers, Cin. Quart. Journ. Sci. I: 210.
1876. *Tischeria aenea* Frey and Boll, Stett. Ent. Zeit. XXXVII: 220.
1878. *Tischeria aenea* Frey and Boll, Stett. Ent. Zeit. XXXIX: 254.
1878. *Tischeria aenia* Chambers, Bull. Geol. and Geogr. Surv. of Terr. IV: 99.
1890. *Tischeria aenea* Walsingham, Ins. Life II: 326.
1923. *Tischeria aenea* Forbes, Mem. 68, Cornell Univ. Agric. Exp. Sta., p. 147.

Face white, with slight metallic luster, head bronzy lustrous, antennal shaft in the male with long cilia, in the female with very fine short cilia toward tip. Fore wings very lustrous metallic coppery and becoming darker and slightly purplish tinged at apex. (The brilliancy of the luster varies considerably.) Hind wings dark bronzy purplish, cilia concolorous; near base of costa, a line of black scales scarcely projecting. Legs dark gray, hind tarsi white above. Abdomen blackish bronzy.

Alar expanse 6.5 to 7.5 mm; a Brownsville, Texas series 5.8 to 6 mm.

Male genitalia (figs. 82, 82a). Vinculum very obtusely angled; harpe

broadly rounded at apex, clothed inwardly with long setae; anellus cylindric, its lateral margins sclerotized; aedeagus forking at two-thirds the length of the stalk, forks narrowing to the acute apices, clothed with scale-like cuticular outgrowths of several sizes; forks of uncus not widely separated, the sclerotization between them with a median pair of elliptical lobes, not always defined.

Female genitalia (fig. 128). Ovipositor and lateral lobes equal in size, peg setae of the ovipositor lobes slender, some elongate and curved, setae of lateral lobes variable; sex opening posteriorly angled; posterior apophyses slender, anterior apophyses as long as the posterior apophyses; prela moderate in size, curved outwardly at apices.

Specimens examined. — 40 ♂, 39 ♀, 20, sex not determined.

TEXAS: Brownsville, 10, ♂, ♀, "Plant 40", dates of emergence from January 31 to February 8, 1932 (S. W. Frost) [USNM].

OKLAHOMA: Dripping Springs, Delaware County, 1 ♂, 2 ♀, rearing record B.1639, on *Rubus* sp., imagoes July 24, 1938 [AFB].

ARKANSAS: Devil's Den State Park, Washington County, 1 ♀, VII.21. 1966 [USNM].

MISSISSIPPI: "Agr. Col. 26 May, 1921," 1 ♂ (L. D. Henderson) [USNM].

FLORIDA: Inverness, 2 ♂, 13 ♀, "ex Blackberry, XI.1.66" (Q. Medlin) [C. P. Kimball Collection].

DISTRICT of COLUMBIA: Washington, 1 ♂, 2 ♀, "3497, 22/8,84, 25/8,84" (Riley Collection) [USNM].

NEW JERSEY: Essex County Park, 1 ♂, "Aug.28 Trap", 1 ♂, "K749, iss. VIII.23" [USNM]; New Lisbon, 1 ♂, 1 ♀, "leaf miner on blackberry, upper side, emerged New Lisbon, N. J. May 26, 1940" [Darlington Collection, ANSP].

CONNECTICUT: East River, 1 ♂, "Aug." [USNM].

PENNSYLVANIA: Hazleton, 3 ♂, 2 ♀, *Rubus*, April, May, August dates [USNM].

NOVA SCOTIA: Ohio, 6 ♂, 5 ♀, "*Rubus*, 60-182", 13.VIII to 19.IX. 1960 [CNC].

ONTARIO: Merivale, 1 ♂ "*Rubus* sp. 59-43", June 5, 1959; 1 ♀, "*Rubus* sp. 59-127", Aug. 25, 1959 [CNC].

OHIO: Cincinnati, 9 ♂, 2 ♀, rearing record B.374, on *Rubus* sp., imagoes August and September [AFB]; Cincinnati, 2 ♂, 1 ♀, rearing record B.374, on *Rubus frondosus* [USNM]; Lynx, Adams County, 1 ♂, on *Rubus occidentalis* L. [AFB]; Beaver Pond, Adams County, 1 ♂, B.1329, on blackberry, 1 ♀, B.1376, on dewberry; Mineral Springs, Adams County, 1 ♀, B.1377, on blackberry; Shawnee State Forest, Scioto County, 1 ♀, B.2143, on *Rubus allegheniensis* Porter, imago IX.11.1950; Fort Hill State Memorial, Highland County, 1 ♂, on *Rubus allegheniensis*, imago VI.22.1965 [AFB].

KENTUCKY: Lewis County, 1 ♂, 2 ♀, on *Rubus* sp., imagoes August 17, 1931 [AFB]; Morehead, Rowan County, 5 ♂, 4 ♀, 10 ♂,♀, "*Rubus* K13-62", imagoes September 14 to 19, 1962 [CNC].

WEST VIRGINIA: Lost River State Park, 1 ♂, on *Rubus* sp., imago September 19, 1938 [AFB].

The larvae are miners in leaves of a number of species of *Rubus;* specimens have been reared from *Rubus villosus* Ait. (cited by Frey and Boll), *R. frondosus* Bigel., *R. occidentalis* L., *R. allegheniensis* Porter, and *R. flagellaris* Willd. The mine (fig. 46) usually lies between two lateral veins, but sometimes crosses a vein; it gradually increases in breadth, with the circular hole for ejection of frass placed at the beginning of the mine. As the feeding period progresses, the loosened epidermis is drawn into several prominent longitudinal folds and the leaf drawn together, as in the oak feeders. Pupation takes place in a silken-lined chamber beneath the longitudinal folds. The pupa (fig. 20) agrees in structure with the pupae of Section I, that is, in the presence of long forked setae.

The degree of luster of the fore wings is variable; relaxing, with probable wetting of the wings, seems to destroy the luster.

All of the eastern miners of *Rubus* are referable to *T. aenea.* On the Pacific Coast, another species (*T. splendida* new species) occurs.

(26) Tischeria splendida new species (Figs. 83, 83a, 129.)

Face whitish, tuft blackish, darker than the fore wings, antennal stalk in the male with long cilia, in the female with fine very short cilia for the entire length. Fore wings brilliant lustrous metallic, bronzy near base shading gradually to the lustrous reddish apical area, cilia reddish tinged around apex. Hind wings pale gray in male with pale cilia, darker in female with cilia tinged with red; a line of black scales near base of costa. Legs gray, hind tarsi whitish, with some fuscous shading. Abdomen purplish black.

Alar expanse 6.5 to 7 mm.

Male genitalia (figs. 83, 83a). Vinculum acutely angled, scarcely produced; harpes broad, setae moderate in length; anellus cylindric, with a flat median ventral lobe; stalk of aedeagus widened in proximal third, a short broad lobe at outer basal angle of each fork, membrane extending beyond the spined area in an elliptic curve, the cuticular outgrowths elongate and sharply acuminate; forks of uncus acuminate, a short quadrate sclerotized area between them, from which the forks curve distad.

Female genitalia (fig. 129). Ovipositor and lateral lobes subequal, peg setae elongate and hooked; sex opening transverse; posterior apophyses slender, not expanded at tips; prela curving spoon-shaped at tips.

Type. — ♂, "Russelmann Park, Contra Costa Co., Calif., II.24.61, emerged III.10.61, reared from *Rubus vitifolia,* J. Powell, Collr." [UCB].

Allotype. — ♀, same data as the type, except emergence III.6.61. [UCB].

Paratypes. — 3 ♂, 1 ♀, same data as the type, except emergence III.6 and III.7.61 (♂'s), III.17.61 (♀) [UCB]; 2 ♂, 1 ♀, San Leandro, California, IX.13 to IX.17.09 [AFB]; 2 ♂, 2 ♀, "Alameda Co., Cal. Apr.", ♂ genitalia slide 9927 J. F. G. C. [USNM].

The larvae are miners in leaves of *Rubus vitifolius* (*Rubus ursinus vitifolius* (Cham. & Schlecht.); the early stage of the mine is similar to that of *T. aenea;* no further information on the life history is available. *Tischeria splendida* has been confused with *T. aenea* Frey and Boll. However, it differs from that species in the lustrous metallic reddish apical area in contrast to the purplish tinge of the fore wings in *T. aenea*... Genitalic differences further separate the two species. Geographically, *T. aenea* is confined to the area east of the Rocky Mountains; *T. splendida,* as far as its range is known, occurs only in California.

(27) Tischeria insolita new species (Figs. 84, 84a, 130.)

Face pale yellow, head blackish purple, cilia of antennal stalk of male very long, especially in basal half, cilia of female longer than width of segments. Fore wings broader than in most of the species, dark blackish purple, entire wing with purple luster and distinctly irrorate because of the paler bases of the scales; a definite line of black scales around apex, cilia paler. Hind wings and cilia dark gray, purplish tinted; a dense line of projecting scales near base of costa. Legs dark blackish purple, hind tarsi whitish. Abdomen black, purple tinged.

Alar expanse 6.5 mm.

Male genitalia (figs. 84, 84a). Anterior margins of vinculum joining at a right angle and thence produced as a long rod; harpe broad, narrowly rounded toward costa, densely setose with fine setae; anellus a slightly tapering cylinder; stalk of aedeagus long, forks broad, densely clothed with scale-like cuticular outgrowths (spinules), the spinules increasing in size and breadth toward tip of fork, membrane extending beyond the spinulose area; forks of uncus widely separated, rather short.

Female genitalia (fig. 130). Ovipositor lobes not greatly exceeding the lateral lobes in size, peg setae short and tapering; sex opening with median posterior lobe; posterior apophyses long, gradually and slightly enlarging at tips; prela large in basal two-thirds, slender in apical third.

Type. — ♂, "Leaf miner on edge of blueberry leaf, emerged New Lisbon, N. J. June 5, 1947" (E. P. Darlington) [ANSP, Type No. 7817].

Allotype. — ♀, same data as the type, except date of emergence June 3 [ANSP].

Paratypes. — 1 ♂, 1 ♀, same data as the type, except dates of emergence June 1 (♂), June 2 (♀) [ANSP].

The four moths were reared by Emlen P. Darlington from narrow mines at the margins of the leaves of *Vaccinium corymbosum* L. An example of these mines accompanies the type series. Under the heading of *Tischeria malifoliella* Clemens, Dr. Darlington writes (Trans. Amer. Ent. Soc. LXXVIII: 56) "The mines were along the edges of cultivated blueberry leaves (*V. corymbosum*), upper side, producing a slight roll to the leaf edge. The larva were still active when disturbed in mines November 10. Imagoes appear in early June. The fore wing has a purplish iridescence, not golden, as noted by Forbes under *malifoliella.*"

The unusual food plant for a species of this section raises the question of the possibility of accidental deposition of eggs on blueberry. However, in genitalic characters, *T. insolita* is distinct from all other species; in these characters, it is nearest to *T. agrimoniella,* especially in the forks of aedeagus, but other characters in both sexes separate it from that species.

(28) **Tischeria confusa** new species (Figs. 85, 85a, 85b, 131.)

Face whitish, more or less shaded with gray, sometimes entirely gray, head blackish; antennae toward tip with segments short and appearing crowded, cilia of male long, cilia of female short, about as long as width of segment, antennae appearing thickened toward apex in female because of the closely placed setae. Fore wings lustrous bronzy or coppery, with purplish tinge toward apex. Hind wings pale gray in male, somewhat darker in female; black scales along base of costa less decumbent (than in species 29) and not appearing as a black line, scales a little larger and broader (than in species 29). Legs dark bronzy, hind tarsi whitish. Abdomen bronzy.

Alar expanse 6 to 6.5 mm.

Male genitalia (figs. 85, 85a, 85b). Vinculum produced to an acute angle; harpe broad, rounded, setae short; anellus with a pair of ventral flaps; stalk of aedeagus long, a little wider proximally, forks clothed with broad scale-like cuticular outgrowths; forks of uncus short, acuminate when viewed laterally, widely separated.

Female genitalia (fig. 131). Ovipositor and lateral lobes subequal, peg setae long and curved; sex opening large; posterior apophyses slender, gradually expanding toward tips; prela large in basal two-thirds, slender in apical third, with sclerotized tips.

Type. — ♂, Sacramento, California, VIII.6.51, reared from Strawberry (W. H. Lange, Collector) [USNM, Type No. 71293]. ♂ genitalia slide 9926 JFGC [USNM].

Allotype. — ♀, Sacramento, California, VIII.3.1951, reared from Straw-

berry (W. H. Lange, Collector) [USNM].

Paratypes. — 3 ♂, 8 ♀, Sacramento, California, imagoes in early August, 2 ♂, 2 ♀, imagoes in April, 1951 [USNM]; 5 ♀, Morgan Hill, Santa Clara County, California, reared from Strawberry, mines VI.9.53, imagoes VI.23.53 (W. W. Allen) [UCB].

The larvae are miners in leaves of the cultivated strawberry. Two species are represented, *T. confusa,* new species, here described, and the following species; these were not separated in the rearings, and only through preparation of genitalic slides have two species been recognized. The moths may be separated into the two species by minute characters of the antennae and scaling of the costa of the hind wings, as noted under the descriptions of the respective species.

The following quotation from an article in California Agriculture, July, 1958, by Leslie M. Smith, William W. Allen, and W. Harry Lange, Jr. entitled "Strawberry Leaf Miner Damage," with illustrations of mined leaves, may be applicable to either or both of these species.

> "The serpentine mines of the larvae appear white and radiate outward from the midveins on the upper surface of the leaflets. The mines may be 1/2″ — 1″ long. Larvae eat only the palisade parenchyma, and do not feed on the spongy parenchyma nor on the veinlets. The tunnels are webbed from the start which keeps the spongy parenchyma from drying out. The epidermis of the leaf is usually puckered along the mid-line of the burrow and especially so over the pupal chamber. The lower surface of the leaf is drawn into a U-shaped groove and the edges of the leaves may roll inwardly due to desiccation of the tissues. . . . . Eggs are laid only on the lower surface of the leaflets and usually near the base of the blade or close to the main veins. The larvae enter directly into the leaf through a crescent-shaped hole cut in one end of the egg. Excrement is pushed out through a hole cut in the egg-shell."

(29) Tischeria inexpectata new species (Figs. 87, 87a, 132.)

Face whitish, more or less shaded with bronzy gray; head dark bronzy; segments of antennal stalk similar throughout, not short and appearing crowded toward tip, but slightly serrate, cilia of male long, densest toward tip, cilia of female short. Fore wings lustrous bronzy or coppery throughout, purple-tinged toward apex. Hind wings gray, cilia concolorous; costal mar-

gin near base with a *line* of decumbent black scales not projecting. Legs blackish, hind tarsi whitish outwardly. Abdomen blackish bronzy.

Alar expanse 6 to 6.5 mm.

Male genitalia (figs. 87, 87a). Vinculum produced into a short rod; harpes broad, triangular, setae very short; anellus nearly hemispherical; stalk of aedeagus long, forks triangular, each fork along base with a row of large sharp-pointed, acuminate, tooth-like cuticular outgrowths, some of them branched; forks of uncus widely separated.

Female genitalia (fig. 132). Ovipositor and lateral lobes equal, both pairs small, peg setae slender and curved; sex opening transversely elliptic; posterior apophyses long and slender throughout; basal broad and apical slender sections of prela of about equal length, curved at tips.

Type. — ♂, Sacramento, California, "reared from Strawberry: VIII.6.51" (W. H. Lange) [USNM, Type No. 71294].

Allotype. — ♀, Sacramento, California, "Strawberry, IV.20.1951" (W. H. Lange) [USNM].

Paratypes. — 20 ♂, 6 ♀, Sacramento, California, all reared from Strawberry, August dates of emergence (W. H. Lange) [USNM]; 3 ♂, Sacramento, California, reared from Strawberry, April dates of emergence (W. H. Lange) [USNM]; 1 ♀, Morgan Hill, Santa Clara County, California, mine VI.9.53, imago VI.23.53 (W. W. Allen) [UCB].

As in the preceding species, the larvae are miners in leaves of strawberry, and the description of larval habits quoted there may be applicable to either species.

The segments of the antennal stalk are similar throughout in *T. inexpectata,* not short and appearing crowded toward tip as in *T. confusa,* and the scales along base of costa of hind wing appear as a black line by transmitted light. The aedeagus of the male genitalia at once separates *T. inexpectata* from all described species of the section except *T. amelanchieris* new species and *T. admirabilis* Braun, both of which are abundantly distinct from it.

(30) Tischeria amelanchieris new species (Figs. 86, 86a, 133.)

Face white; forward projecting scales of tuft white, with blackish tips, or sometimes wholly dark; scales of scape white, black-tipped and sometimes wholly dark, antennal shaft in male with very long cilia, especially in basal half, in female with cilia longer than the width of a segment. Fore wings shining, entire wing with a dark purple luster, cilia dark purple from apex to tornus. Hind wings gray, purplish toward apex, cilia purplish; base of costa with a line of projecting black scales. Hind femora white, tibiae and hairs blackish, tarsi white. Abdomen dark purplish black.

Alar expanse 5.5 to 6.5 (♂ type).

Male genitalia (figs. 86, 86a). Vinculum prolonged into a slender rod; harpes angled before the well-defined cucullus, cucullus with heavy setae fringing the ventral margin; anellus nearly hemispherical, aperture large; stalk of aedeagus about two and a half times the length of the forks, each fork with a double row of large, acuminate, sharp tooth-like cuticular outgrowths along base; forks of uncus incurved to sharp points.

Female genitalia (fig. 133). Ovipositor lobes larger than the lateral lobes, peg setae of moderate length, straight; sex opening convex and sclerotized posteriorly; posterior apophyses long, foot-shaped at tips; prela curved and spoon-shaped at tips.

Type. — ♂, Fort Hill State Memorial, Highland County, Ohio, rearing record B.2388 on *Amelanchier arborea* (Michx. f.) Fern. Mine collected June 16, imago July 2, 1965 [AFB].

Allotype. — ♀, Mineral Springs, Adams County, Ohio, rearing record B.1319, on *Amelanchier arborea,* mine collected July 20 (in pupal state), imago July 25, 1927 [AFB].

Paratypes. — 1 ♂, 1 ♀, Mineral Springs, Adams County, Ohio, rearing record B.1319, on *Amelanchier arborea,* imagoes July 25, 1927 [AFB]; 1 ♂, 2 ♀, Cumberland Falls State Park, Kentucky, "on *Amelanchier*", imagoes July 2 and July 5 [AFB].

Tischeria amelanchieris is an extremely rare species; the mines, so far as I have observed, occur on *Amelanchier arborea* growing in ravines or other mesic situations, never in exposed xeric situations. The mine is similar to that of *T. crataegifoliae* on *Crataegus* spp.

The moth is characterized by the purple luster of the entire fore wings. Genitalic characters of the male are distinctive.

(31) Tischeria admirabilis Braun (Figs. 15, 44, 88, 88a, 134.)

1925. *Tischeria admirabilis* Braun, Trans. Amer. Ent. Soc. LI: 16. Type ♂, Sardinia, Brown County, Ohio [AFB].

Face brownish ocherous; head bronzy fuscous, scales closely appressed, not tufted, antennal scape very small with scales scarcely projecting, shaft white or whitish in apical half, cilia in male long, especially in basal half, in female short. Thorax bronzy fuscous. Fore wings at base and below fold brilliant golden; from base the wing shades outwardly through brilliant bronzy red and purple tints to shining dark blue around apex and along termen; the blue scales are tipped with gold; cilia grayish purple. Hind wings wider than in most species (fig. 15), gray with faint purplish tinge. Legs gray, hind tarsi yellowish white, the basal segments sometimes gray. Abdomen bronzy fuscous.

Alar expanse 6 to 8 mm.

Male genitalia (figs. 88, 88a). Vinculum strongly sclerotized, a median

posteriorly directed pointed lobe; harpes broad, parallel-sided; anellus a broad tapering truncated cone, a small median ventral flap; stalk of aedeagus relatively short, each fork at its outer angle with a cluster of long pointed cuticular outgrowths, concealing much of the sharp-pointed forks; forks of uncus broad, but acute when viewed laterally, separated by a crescent-shaped sclerotization.

Female genitalia (fig. 134). Ovipositor and lateral lobes subequal, peg setae pointed; sex opening transverse, posterior margin obtusely angled; posterior apophyses slender throughout; prela small, inwardly curved distad.

Specimens examined. — 15 ♂, 15 ♀.

OHIO: Brown County, ♂ type, 2 ♂, 3 ♀ paratypes, rearing record B.1094, on *Rosa palustris* Marsh., mines collected in June and July, imagoes in latter part of July; Fort Hill State Memorial, Highland County, 4 ♂, 5 ♀, rearing record B.2458, on *Rosa carolina* L. (*R. humilis*), mines collected September 25, 1967, imagoes in April, 1968; Cedar Falls, Adams County, 2 ♂, 2 ♀, on *Rosa carolina*, imagoes in early May; Lynx, Adams County, 1 ♂, 3 ♀, rearing record B.2438, on *Rosa carolina*, imagoes early April; Buzzardroost Rock, Adams County, 1 ♂, 1 ♀, on *Rosa carolina*; Beaver Pond, Adams County, 2 ♂, 1 ♀, rearing record B.1094a, on *Rosa carolina*, imagoes in late July; Cedar Swamp, Champaign County, 1 ♂, on *Rosa palustris*, larva in September, imago April 20 [AFB].

IOWA: Sioux City, 1 ♂, July (C. N. Ainslie) [USNM].

The larvae are miners in leaves of species of *Rosa*. In wet or swampy areas, the mines occur on *Rosa palustris* Marsh.; more commonly they occur in leaves of *Rosa carolina* L. (*R. humilis*). The mines often occupy more than half of a leaflet, thus crossing the midrib; at time of pupation, the leaf is rolled concealing most of the loosened epidermis (fig. 44). The mine thus differs from that of *T. roseticola,* which is narrowly elongate and lies along the margin of a leaflet, not reaching the midrib.

The brilliant luster of the fore wings and the white apical half of antennae separate this species from all described American species. It is closest to the European *T. angusticolella* Dup., also a miner of *Rosa,* and agrees with it in the white-tipped antennae, but is much more lustrous and brilliantly colored than that species. However, specimens of *T. admirabilis* killed too soon after emergence have not developed the typical brilliant coloration, and are superficially scarcely distinguishable from *T. angusticolella.*

The remarkable armature of the forks of aedeagus is distinctive.

Section III
Species 32 to 42

The species of this section are miners in leaves of members of the Compositae. The ground color of the fore wings is in general ocherous, with bands or patches of dark-tipped scales, the limits of the marks ill-defined. The two preceding sections agree with the accepted concept of the genus. The species comprising Section III exhibit well-defined characters not present in the typical species. Two spine-like setae arise from the base of the labial palpi (fig. 2). In the fore wing, Cu bends abruptly at the end of the cell, thence extends as a short spur to the inner margin (figs. 16, 17). In contrast to the two preceding sections, the abdominal setae of the pupa are short and not forked at the ends (fig. 21 and Mosher, 1916). Two structures of the male genitalia are characteristic of this section: socii are present and the costal area of the harpe has developed into strongly sclerotized teeth. Vinculum strongly sclerotized throughout; harpes divided or nearly divided, costal area developed into heavily sclerotized teeth; at base of harpe, a short acicular process adjacent to anellus; juxta usually present; transtilla absent, its function seemingly taken over by the teeth of harpe, which, before spreading, curve dorsad of the anellus; anellus with two ventral rows of setae; aedeagus variable, the forks usually acute, sometimes with thin lateral expansion; socii small erect setose lobes lying at the base of the uncus and partially overlying the forks of uncus, which in this section are small triangular bodies. The female genitalia, although conforming to the general type, show several distinctive features. The peg setae of the ovipositor are small, but black; the eighth sternite is not reduced, but midventrally it may be produced anteriorly, and then forked into the two arms of the patibulum; the prelum is highly specialized, its distal slender portion long, its tip modified and pressing into a depressed sclerotized area on the enlarged portion of the ductus bursae (figs. 137, 141, 142).

Key to the Species of Section III

Based on Coloration and Markings, Food Plants and Mines [6]

1. Fore wings creamy white, markings on apical third only (see also No. 32) ..... (42) *pallidipennella*
   Fore wings some shade of ocher — pale whitish ocherous, dull or bright ocherous, brownish ocherous, or gray tinged with ocher 2
2. An oblique dark bar or streak from basal third of costa, sometimes meeting a dark spot on dorsum, or often broken in the middle of the wing; a costal spot at two-thirds and a tornal spot 3
   No oblique mark from basal third of costa; well-defined marks mostly confined to the apical third of the wing; there may be spots formed of dark-tipped scales or lines of such scales; costa often darkened 8
3. Fore wings dull grayish ocherous; an oblique dark bar from basal third of costa to middle of wing; near base on dorsum, a dark spot which may project obliquely toward the costal bar. An underside miner in leaves of *Helianthella*; western ..... (38) *gregaria*
   Fore wings ocherous to brownish ocherous, sometimes whitish or grayish; oblique streak from basal third of costa usually meeting dark spot on middle of dorsum 4
4. A short faint diagonal narrow line or bar from basal third of costa, sometimes represented by a discal spot only; a costal dark spot at two-thirds and opposite it a tornal spot sometimes connected with it; costal margin often darkened; forewing sometimes densely dusted. An underside miner in leaves of *Helianthus* spp. ..... (37) some *helianthi*
   Costal bar or streak at one-third usually distinct, but sometimes diffuse and almost obliterated by dark dusting; dark spot at two-thirds usually connected across the wing to a dark tornal spot 5
5. Ground color of fore wing usually a clear bright ocher yellow, sometimes with dusting, markings rather sharply defined. An upper side miner in leaves of *Aster* spp.; a nidus formed; eastern ..... (33) *astericola*
   Ground color not as clear ocher yellow; some shade of ocher, brownish ocher or grayish ocher or pale grayish or whitish ocher; markings less sharply defined and may be obscured by dusting 6
6. Fore wings dull brownish ocherous, densely dusted with fuscous-tipped scales which may obscure the markings. A miner in leaves of *Aster* sp.; a nidus formed; western ..... (34) *occidentalis*
   Fore wings bright ocher, brownish ocherous, or pale grayish ocherous; markings wider and more conspicuous, not obscured by dark dusting 7

[6] Because of the great variability of some species, this key can serve only as an aid for identification.

7. A fine line of brown scales from costa between the streak from basal third of costa and the oblique streak passing from the costal spot at two-thirds to the tornal spot. An upper side miner in leaves of *Heliopsis* and *Ambrosia*; a conspicuous white nidus on upper side of leaf ..... (35) *heliopsisella*

   No such fine line of dark scales; smaller than No. 35; apical cilia usually roseate. An underside miner in leaves of *Ambrosia* spp.; a white nidus on underside of leaf ..... (36) *ambrosiaeella*

8. Fore wings pale creamy or whitish, or ocherous; dark scales may form spots in disc, on mid-dorsum, at tornus, and on costa. An upper side miner in leaves of *Solidago* spp.; a nidus formed ..... (32) *solidaginifoliella*

   No such separated spots; tornal and opposite costal spots may be present or lines of scales may be the only marks 9

9. A few broken lines of black scales the only markings (fig. 4) ..... (40) *heteroterae*

   Wing not thus marked; a tornal spot and usually a costal spot present 10

10. Dark margin of costa widening into a broad stripe at two-thirds and ending before apex, leaving clear undusted ground color between it and the apical area; fore wing pale toward base in female. No nidus constructed in the mine ..... (39) *marginata*

    No such area of clear ground color on costa before apex; apex of wing dusted with dark-tipped scales 11

11. Fore wings bright, almost orange ocherous, immaculate for two-thirds or three-fourths the wing length; tornal spot small ..... (37) some *helianthi*

    Fore wings not immaculate for two-thirds the wing length, a dark spot on mid-dorsum; tornal spot of dense dark scales. A miner of leaves of *Helianthus* sp. ..... (41) *longe-ciliata*

Key to the Species of Section III
Based on Male Genitalia [7]

1. Sclerotized costal area of harpe bifurcate above middle into two oppositely directed sharp teeth; aedeagus dividing above middle into two thin plates ..... (36) *ambrosiaeella*

   Not as above 2

2. Costal area of harpe much enlarged in basal half, abruptly narrowing to a long sharp terminal tooth; forks of aedeagus with acicular tips 3

   Costal area not conspicuously enlarged in basal half 4

[7] Omitted from the key: *longe-ciliata* Frey and Boll, *heteroterae* Frey and Boll.

3. Costal area with short sharp tooth near base, and accessory tooth from base of terminal tooth; forks of aedeagus long and tapering from base of fork ..... (39) *marginata*
   Costal area with a terminal sharp tooth only; forks of aedeagus abruptly narrowing to the acicular tips ..... (38) *gregaria*
4. Costa with the sharp tooth near base the only tooth; aedeagus short, with large bulbous base and broad thin forks ..... (42) *pallidipennella*
   Not as above 5
5. Terminal tooth large, sharp, and strongly incurved; teeth arising from base of costa 6
   Teeth not arising from base of costa, and not appreciably curved 8
6. A single large curved tooth; vinculum tapering to a rounded point; aedeagus forking near base into thin plates, acuminate at tips ..... (33) *astericola*
   At least one accessory tooth 7
7. A small tooth near base of large tooth, no other teeth; aedeagus very large, bulbous at base; each fork broadly expanded at tip ..... (35) *heliopsisella*
   The large curved tooth with small basal accessory tooth, and two large lateral teeth; aedeagus small, forks convergent, acute ..... (34) *occidentalis*
8. Sclerotized area of costa separated from membranous area by a narrow sinus, tooth short, without accessory teeth; vinculum tapering to the narrow rounded tip; forks of aedeagus swollen near tips, then diverging and acuminate ..... (32) *solidaginifoliella*
   Sclerotized area separated from membranous area by a broad sinus, tooth with accessory bifid tooth; vinculum broadly rounded; forks of aedeagus with rounded tips ..... (37) *helianthi*

Key to the Species of Section III
Based on Female Genitalia [8]

1. Sternite of segment 8 not or scarcely produced midventrally; arms of patibulum arising separately 2
   Sternite of segment 8 produced midventrally and then forking into the arms of the patibulum 6
2. Arms of patibulum approximate at origin and parallel before diverging 3
   Arms of patibulum diverging from origin 4
3. Peg setae of the ovipositor lobes closely placed; a lateral sharp point at tip of prelum ..... (35) *heliopsisella*
   Peg setae of ovipositor lobes slender and widely separated; prelum curved toward tip, a triangular lateral projection ..... (34) *occidentalis*

[8] Omitted from the key: *longe-ciliata* Frey and Boll, and *pallidipennella* new species.

4. Arms of patibulum separated at origin by a broad sinus along margin of sternite 5
   Arms of patibulum separated by a V-shaped sinus; peg setae thicker than their distance apart; outer half of distal section of prelum enlarged and curved ..... (33) *astericola*
5. Peg setae thick and short; prela long and slender, near tips a membranous elongate projection ..... (32) *solidaginifoliella*
   Peg setae slender; prelum slender basally, toward tip with large triangular projection ..... (37) *helianthi*
6. Sternite of segment 8 midventrally very long produced, the production twice the length of the short arms of patibulum; peg setae very small ..... (40) *heteroterae*
   Sternite of segment 8 not abnormally long produced, the production not longer than the arms of patibulum 7
7. Sternite of 8 very shortly and narrowly produced, and soon forking into the long (wide at origin) arms of patibulum ..... (38) *gregaria*
   Sternite of 8 longer produced 8
8. Peg setae few and slender; prela abruptly enlarged at tips and each bearing two minute spines ..... (36) *ambrosiaeella*
   Peg setae thick; prelum with outward curve before the narrow spoon-shaped tip ..... (39) *marginata*

(32) Tischeria solidaginifoliella Clemens

(Figs. 50, 50a, 89, 89a, 135.)

1859. *Tischeria solidagonifoliella* Clemens, Proc. Acad. Nat. Sci. Phila., 306. (Type not now in existence.)
1871. *Tischeria solidagonifoliella* Chambers, Can. Ent. III: 208.
1872. *Tischeria solidagonifoliella* Stainton, Tin. No. Amer., p. 81.
1878. *Tischeria solidagonifoliella* Frey and Boll, Stett. Ent. Zeit. XXXIX: 257.
1890. *Tischeria solidaginifoliella* Walsingham, Ins. Life II: 324.
1903. *Tisheria solidagonifoliella* Busck, Proc. Ent. Soc. Wash. V: 190.
1923. *Tischeria solidaginifoliella* Forbes, Mem. 68, Cornell Univ. Agric. Exp. Sta., p. 147.

All of the above references except Walsingham (1890) and Forbes (1923) use the original Clemens' spelling of the name; in Dyar's List (1902) and McDunnough's List (1939) the corrected spelling, *solidaginifoliella,* is used.

Head varying in color from cream to pale ocherous, antennae whitish, becoming darker toward apex, ciliate in both sexes, cilia very long in male, long in female. Fore wings variable in ground color, pale cream or whitish to ocherous; markings formed by groups of dark-tipped scales with sometimes a scattering of fuscous scales over the entire wing surface; there is great varia-

tion in the presence of the patches of darker scales, some of which may form clearly defined markings; in some specimens, there is no grouping of dark scales, but merely a dusting of fuscous scales, a little denser along costa, in the area where the costal patch (as described by Clemens) lies. Well-marked specimens may be described as follows: a small spot in disc at about one-third the wing length, with a few scattered dark scales or a small spot before it; a line of dark scales along dorsum, which may form a well-defined spot at mid-dorsum; a relatively large patch just above tornus, costal margin more or less darkened with fuscous scales, which may form a dark spot on costa opposite the space between the mid-dorsal and tornal spots; apical area of the wing darkened with scattered fuscous scales, somewhat grouped at apex and on termen. Cilia pale cream or whitish ocherous. Hind wings whitish to pale fuscous ocherous. Legs whitish, shaded with fuscous in darker specimens. Abdomen whitish to pale brownish ocherous.

Alar expanse 6.5 to 8 mm.

Male genitalia (figs. 89, 89a). Entire vinculum strongly sclerotized, tapering anteriorly to the narrowed rounded tip; harpe nearly divided, costal area short, heavily sclerotized and modified into a short curved tooth, cucullus narrow, apically with heavy setae; at base, adjacent to anellus, a short acicular process; anellus with ventral sinus; aedeagus forking before middle, the forks swollen toward tip, then diverging and sharply acuminate; socii lobed, setose, and concealing the small and acutely triangular uncus forks.

Female genitalia (fig. 135). Peg setae of ovipositor short, thick, and dark pigmented, lateral lobes small, outer margins thickened; sex opening without sclerotized margins; posterior apophyses slender; arms of patibulum diverging from middle of anterior margin of eighth sternite; prela long and slender, near tips a membranous elongate projection.

Specimens examined. — 38 ♂, 51 ♀.

NOVA SCOTIA: Ohio, 3 ♀, "*Solidago*, 25.VIII.1960" [CNC].

QUEBEC: Valtetreau, 1 ♂, 3 ♀, *Solidago hispida*; Kingsmire, 1 ♂, 3 ♀, "Goldenrod, Aug. 8, Aug. 18-19, 1955"; Fairy L., 1 ♂, 1 ♀, 6.IX, 7.IX, 1955 [CNC].

ONTARIO: Simcoe, 9 ♂, 6 ♀, Solidago sp., Aug. 20-27; Merivale, 2 ♂, 2 ♀, *Solidago hispida*, May 31, 1959; Ottawa, 1 ♂, 2 ♀, Solidago, 26.VIII to 2.IX, 1966; Normandale, 1 ♂, 1 ♀, *Solidago*, 27 & 28 July [CNC].

CONNECTICUT: East River, 5 ♂, July 21-24 [USNM].

NEW JERSEY: Essex Co. Pk., 3 ♂, 2 ♀, July 18, 20, Sept. 11 [USNM].

DISTRICT of COLUMBIA: 1 ♀, "3488, 25/8 84, *Solidago*"; 1 ♀, "leaf mine on *Solidago*, iss. Oct. 6.88" [USNM].

OHIO: Cincinnati, 2 ♂, 11 ♀, rearing record B.401, on *Solidago* sp., imagoes in June and August [AFB]; 1 ♂, 3 ♀, rearing record B.401, June, July, and September dates [USNM]; 1 ♂, 2 ♀, rearing record B.2380, on *Solidago sphacelata* Raf., imagoes July 30, 31 [AFB]; Clermont County, 1 ♂, 3 ♀, on *Solidago* sp., imagoes May, June, September [AFB]; Lynx Prairie,

Adams County, 2 ♂, 2 ♀, rearing record B.2382 on *Solidago juncea* Ait., imagoes in August, 1964 [AFB]; Beaver Pond, Adams County, 2 ♀, *Solidago* sp. [AFB]; Shawnee State Forest, Scioto County, 1 ♂, 1 ♀, rearing record B.2433, on *Solidago rugosa* Ait., imagoes in August [AFB]; Fort Hill State Memorial, Highland County, 1 ♀, rearing record B.2326, on *Solidago* sp., imago August 15, 1962 [AFB].

KENTUCKY: Morehead, Rowan County, 1 ♂, on *Solidago rigida* L., imago September 23; Fleming County, 1 ♀, on *Solidago* sp., imago August 28; Pine Mountain, Letcher County, 1 ♂, June 24 [AFB].

MISSOURI: Hollister, Caney County, 1 ♂, rearing record B.1632, on *Solidago* sp., imago July 24 [AFB].

ARKANSAS: Ozark National Forest, 3 ♂, rearing record B.1648, on *Solidago* sp. [AFB].

In addition to the above records, Forbes (1923) records this species from New York, and Walsingham (1890) records it from Texas.

The bluish iridescent egg is deposited on the upper surface of a leaf. The larva at first mines a small blotch; later, as the mine expands, the construction of the nidus is initiated near the beginning of the mine and some silk is spun leading toward the nidus from the enlarging area of the mine. The nidus, at first very slight, becomes more pronounced because of additional silken lining (fig. 50), but at no time is as conspicuous as that of the following three species. On the underside of the leaf, the mined area remains green (fig. 50a).

At emergence, the pupa is thrust through the lower epidermis of the leaf, adjacent to the nidus.

The aspect of very pale specimens might throw some doubt as to their specific identity, but a genitalic slide of one of these from Simcoe, Ontario, in the Canadian National Collection, establishes their identity.

(33) **Tischeria astericola** new species

(Figs. 17, 21, 53, 53a, 90, 90a, 90b, 136.)

Face ocherous, head rough-tufted, the scales varying from whitish to brownish ocherous, antennal stalk in male with long cilia, in female with fine short cilia. Ground color of fore wings varying from a clear bright ocher yellow to brownish ocherous, and sometimes dusted with fuscous scales. Groups of fuscous scales form the markings: from basal third of costa a line or band of such scales (sometimes faint) extends diagonally across the wing sometimes meeting a patch of fuscous scales on the middle of the dorsal margin, but more often broken in the middle of the wing; from two-thirds of costa a broader band extends diagonally across the wing and

joins a larger patch of fuscous scales at tornus; on costa, this band often increases in size and may merge with the fuscous scales before apex; the costal margin from base is darkened in varying degree; a few fuscous scales may be present in the fold near base; apical area of the wing usually with an admixture of fuscous scales, but in those specimens with the bright ocher ground, the fuscous scales may be present as a small costal spot only. Cilia pale ocherous or brownish around apex, shading to fuscous at tornus. Hind wings and cilia fuscous. Legs ocherous, more or less shaded with fuscous. Abdomen ocherous, with fuscous dusting, dense in darker specimens.

Alar expanse 7.5 to 8.5 mm.

Male genitalia (figs. 90, 90a, 90b). Vinculum tapering to a rounded point; costa of harpe developed into a single large curved and heavily sclerotized sharp-pointed tooth, cucullus slender, setose; anellus with deep sinus dorsally, ventrally with a pair of sharp spine-like teeth; aedeagus (fig. 90b) bulbous at base, with cornutus, forking near mid-length into the thin rapidly narrowing acuminate forks; socii slender elongate setose lobes, not exceeding forks of uncus; forks of uncus narrowly triangular, sharp-pointed.

Female genitalia (fig. 136). Ovipositor lobes densely clothed with short peg setae, thicker than their distance apart; lateral lobes small, setae long; sex opening concealed by a sclerotized projection of anterior margin; posterior apophyses slender; sternite of 8 scarcely produced and forking into the slender curved arms of the patibulum; bases of prela slender, outer half of the distal slender section enlarged and curved, pressing into the enlarged portion of the ductus bursae.

Type. — ♂, Cincinnati, Ohio, rearing record B.2334a, on *Aster cordifolius* L., mine collected in June, imago June 30, 1963 [AFB].

Allotype. — ♀, Cincinnati, Ohio, rearing record B.2334a, on *Aster cordifolius*, mine collected in June, imago June 28, 1963 [AFB].

Paratypes. — 1 ♀, same data as the type, except imago July 2; 3 ♂, 4 ♀, Cincinnati, Ohio, rearing record B.2334, on *Aster cordifolius*, mines collected in early September, imagoes September 14 to 24; 1 ♂, 2 ♀, Beaver Pond, Adams County, Ohio, rearing record B.1475, on overwintering basal leaves of *Aster cordifolius*, mines collected April 5, imagoes April 26 and April 30, 1935, 1 ♀, on *Aster macrophyllus* L., imago July 5; 4 ♂, Fort Hill State Memorial, Highland County, Ohio, rearing record B.2348, on *Aster cordifolius*, mines June 19, imagoes July 1, July 2, 1 ♀, rearing record B.2421, on *Aster phlogifolius* Muhl., mine October 14, imago October 17, 1 ♀, rearing record B.2409, on *Aster shortii* Lindl., mine October 11, 1965, imago March 23, 1966; 1 ♂, Scioto County, Ohio, rearing record B.2414, mine October 6, imago late October, 2 ♂, rearing record B.2432, mines August 4, imagoes August 15, August 23, on *Aster cordifolius*; 4 ♂, 4 ♀, Pike Lake State Park, Pike County, Ohio, rearing record B.2358, on *Aster shortii*, B.2358a, on *Aster cordifolius*, mines October 10, imagoes late October, 1 ♂, 1 ♀, rearing record B.2369 on *Aster* sp., imagoes June 26 [AFB]; 7 ♂, 6 ♀,

Reese's Bog, Burt Lake, Cheboygan County, Michigan, rearing record B.1977, on *Aster* sp., mines collected July 24 on basal leaves, imagoes August 5 to 8; 1 ♂, Lewis County, Kentucky, on *Aster* sp., imago August 11; 2 ♀, Big Black Mountain, Letcher County, Kentucky, on *Aster* sp., imagoes July 22; 1 ♀, Log Mountain, Bell County, Kentucky, rearing record B.1860, on *Aster* sp., imago October 27; 4 ♂, 5 ♀, Balsam, North Carolina, rearing record B.712, on *Aster* sp., mines collected August 18, imagoes from August 31 to September 15 [AFB]; 3 ♂, 2 ♀, "on Aster, Plummer's I, Md. Sept. 06, Aug. Busck, Collector" [USNM].

The larvae are miners in leaves of a number of species of *Aster*, most commonly *Aster cordifolius* L. There are four, partially overlapping, generations a year; moths emerge in April from mines in basal overwintering leaves; mines of a second generation appear in June, of a third generation in late July and early August, of the fourth generation in September or early October; moths of this generation emerge in late September and in October, and eggs are deposited on the basal overwintering leaves of the food plant. In these basal overwintering leaves, the mine is indistinct, because of the heavier texture of the leaves.

The eggs are deposited on the upper side of the leaves; the early mine (fig. 53a) is a roundish blotch, with the translucent beginning of the mine projecting as a point; the mine is enlarged into an irregular blotch (fig. 53) and the nidus, scarcely discernible in the early mine, becomes distinct; at the time of pupation, it is outlined by a denser ring of silk and projects as a slight convexity on the underside of the leaf.

As in other members of this section, the pupal setae (fig. 21) are short and not forked at tips as in Sections I and II.

Tischeria astericola is a common woodland species, strangely long overlooked. It can be identified by food plant and the characteristic male genitalia.

(34) **Tischeria occidentalis** new species (Figs. 91, 91a, 137.)

Face pale brownish gray, labial palpi large, tuft on head large, scales erect; antennal scape greatly elongated and thickened toward distal end, shaft in both sexes with minute appressed cilia. Fore wings dull brownish ocherous densely and irregularly dusted with fuscous-tipped scales tending to obscure the indistinct markings: dorsal margin and fold at base usually more densely dusted; from basal third of costa, a diffuse and broken diagonal line of scales may cross the wing to a small fuscous spot on dorsum, in the cell,

this line may be present as a distinct spot; at two-thirds of costa, a larger accumulation of fuscous scales narrows and passes across the wing to a tornal spot; apex of wing densely fuscous-dusted, a broken line of fuscous scales around apex at base of cilia; cilia brown at apex, fuscous toward tornus. Hind wings brownish fuscous, cilia darker. Legs grayish, fuscous dusted. Abdomen above densely dusted with black scales, the general aspect a grayish black.

Alar expanse 7 to 8 mm.

Male genitalia (figs. 91, 91a). Vinculum narrowing, broadly rounded anteriorly; harpe divided, costal area heavily sclerotized, with four sharp teeth, a small basal tooth, a slender acuminate tooth at middle, a smaller tooth at three-fourths arising from a wider section, and terminating in a fourth large curved tooth; cucullus slender, tapering to a rounded point at tip, finely setose; anellus with pairs of latero-ventral setae, ventral margin at apex emarginate; aedeagus small, forking beyond middle into two convergent acute forks; socii sparsely setose, long, slender, surpassing the narrow acute forks of uncus.

Female genitalia (fig. 137). Ovipositor lobes small, peg setae slender and not dark-pigmented; lateral lobes very small; sex opening transverse, a median posteriorly projecting sclerotized process from anterior margin; posterior apophyses slender; sternite of 8 not produced, arms of patibulum approximate at origin, parallel, then diverging to articulate with the anterior apophyses; prela slender at origin, very long, curved toward tips, with a triangular membranous projection, and pressing into a concave sclerotized area of the ductus bursae.

Type. — ♂, Jenny Lake, Grand Teton National Park, Wyoming, rearing record B.1451, on *Aster* sp., mine collected July 27, imago August 5, 1934 [AFB].

Allotype. — ♀, same data as the type, except date of emergence August 9 [AFB].

Paratypes. — 3 ♂, 2 ♀, Paint Brush Canyon, Grand Teton National Park, Wyoming, rearing record B.1451, on *Aster* sp., mines July 28, imagoes August 9 and 15; 1 ♂, 4 ♀, Jenny Lake, rearing record B.1451, imagoes August 5 and 9 [AFB].

The larvae are upper side miners in leaves of *Aster* sp. The egg is deposited on the upper side of a leaf, and the early translucent area is easily seen on both upper and lower surfaces of the leaf. The leaf tissue in the blotch mine is mostly consumed except in a circular area on the underside of the leaf below the nidus, which on the upper side of the leaf is definitely outlined, its diameter about 7 mm, noticeably larger than the nidus of the eastern *astericola*.

Mines found on *Aster* near Logan, Utah, and tentatively identified as mines of *T. heliopsisella* Chambers (Braun, 1925, Microlepidoptera of Northern Utah, Trans. Am. Ent. Soc. LI: 219) were prob-

ably mines of *T. occidentalis*.

(35) Tischeria heliopsisella Chambers

(Figs. 22, 48, 48a, 92, 92a, 138.)

1875. *Tischeria heliopsisella* Chambers, Cin. Quart. Journ. Sci. II: 113. Type, Kentucky [MCZ].
1890. *Tischeria heliopsisella* Walsingham, Ins. Life II: 325.
1891. *Tischeria heliopsisella* Walsingham, Ins. Life III: 389.
1923. *Tischeria heliopsisella* Forbes, Mem. 68, Cornell Univ. Agric. Exp. Sta., p. 147.
1876. *Tischeria nolckenii* Frey and Boll, Stett. Ent. Zeit. XXXVII: 220. Type, Dallas, Texas [BM].
1878. *Tischeria nolckenii* Frey and Boll, Stett. Ent. Zeit. XXXIX: 257.
1890. *Tischeria nolckenii* Walsingham, Ins. Life. II: 325.

Face ocherous, tuft with brown-tipped or brown scales; antennal stalk in male with long cilia, in female with fine short cilia. Thorax and fore wings bright ocher to dull brownish ocher, with more or less brownish or blackish dusting; on thorax a median dark brown streak and similar streaks over the tegulae which extend onto the dorsal margin of the fore wing for one-fourth its length; a short brown streak from base of fore wing; costal margin for its entire length dark brown or blackish; from basal third of costa an oblique streak extends across the wing, sometimes broken on the fold, and sometimes meeting a dark spot on middle of dorsum; from costa at apical third, a streak, broad on costa, below costa sometimes little more than a line of scales, passes across the wing parallel to the first streak, to a tornal spot, and from this, in dusted specimens, dark scales may follow termen to apex; between these two streaks, a fine line of brown scales from costa may be connected to them by broken longitudinal lines of scales; from the middle of the second oblique streak, two indistinct lines run to the base of the apical cilia; cilia ocherous or brownish, and in paler specimens with a distinct line of dark-tipped scales projecting into them around apex. Hind wings fuscous, sometimes blackish, and when blackish, the cilia are contrastingly paler. Fore and middle legs brownish fuscous, hind legs ocherous, dusted outwardly, the tarsal segments annulate at joints, or sometimes entirely yellow. Abdomen densely blackish dusted, especially toward tip; anal scales paler.

Alar expanse 7 to 8.5 mm, the smaller specimens usually on *Heliopsis*, the larger on *Ambrosia trifida*.

Male genitalia (figs. 92, 92a). Vinculum broadly rounded; harpe divided, costal area broad near base and heavily sclerotized, the sclerotization including the entire base of harpe; from near base of costa, a median small tooth, costa soon abruptly narrowing into a long curved acute tooth; cucullus slender, acutely rounded at apex, setose; juxta present, a narrow band; anellus cylindric, with lateral acute sclerotized processes; aedeagus very large, bulbous at base,

forking at middle, each fork broadly expanded at tip; socii elongate, surpassing the acute triangular forks of uncus.

Female genitalia (fig. 138). Ovipositor lobes small, peg setae slender and dark, lateral lobes very small, setae variable; sex opening transverse, anterior margin with median projection; posterior apophyses slender; sternite of 8 not produced, arms of patibulum slender, approximate at origin; prela slender throughout, a lateral sharp point at tips; enlarged portion of ductus bursae with a tuberculate band.

Specimens examined. — 12 ♂, 15 ♀.

OHIO: Cincinnati, 2 ♂, 3 ♀, rearing record B.72, on *Ambrosia trifida* L., imagoes September 8; 2 ♂, 3 ♀, rearing record B.300, on *Ambrosia trifida*, imagoes late June and early August; 1 ♂, 1 ♀, flown, September 14 [AFB]; Cincinnati, 2 ♀, rearing record B.300, on *Ambrosia trifida*, imagoes August 12, 2 ♂, 1 ♀, flown, April 29, May 7 [USNM]; Stonelick Lake State Park, Clermont County, 1 ♂, 2 ♀, rearing record B.2329, on *Heliopsis helianthoides*, imagoes October 2 to October 7 [AFB]; Oxford, 1 ♂, rearing record B.530, on *Heliopsis helianthoides*, imago August 17 [AFB]; Lynx Prairie, Adams County, 1 ♀, rearing record B.2340, on *H. helianthoides*, imago March 28, 1 ♂, 1 ♀, rearing record B.2340a, on *H. helianthoides*, imagoes July 4 [AFB].

NEW JERSEY: Montclair (probably), K728, 1 ♂, 2 ♀ without abdomens, "iss.VIII.10" [USNM].

The larvae are miners in leaves of *Heliopsis helianthoides* (L.) Sweet (*H. laevis* Pers.), and several species of *Ambrosia*, most commonly *Ambrosia trifida* L. On *Heliopsis* the mines often occur in great numbers, and those of a later generation may be present on the same leaves with those of the earlier generation. Mines of the early generation are found in June, with emergence of imagoes in early July or sometimes as late as August; in the later generation, the mining period is completed in late August or early September, with emergence of imagoes in September and October; some remain in the pupal state until the following spring. Flown specimens have been taken as late as the middle of October; the moths may hibernate.

The iridescent egg is deposited on the upper side of a leaf; the mine on *Heliopsis* for 1 or 2 mm is a slender trumpet in which all green tissue is eaten, it is later surrounded by the enlarged mine, which does not however include the egg. In the mine, the upper epidermis is loosened. In the early stage of the mine, the green tissue is not completely consumed and the mine has a greenish aspect, and the area of the nidus is not perceptible unless the mine is held up to the light (fig. 48a); as feeding continues, all green tissue is eaten,

except in the circular area where the nidus is being formed; the nidus becomes apparent very soon; it lies near the beginning of the mine. At time of pupation (fig. 48) the nidus is densely lined with silk and attached around its circumference; on the upper side of the leaf it is conspicuously white as the dense silk lining is spun just below the upper epidermis of the leaf; on the underside of the leaf it forms a rounded protuberance. Mines on *Ambrosia* are identical in appearance. Figure 22 illustrates the larva in the last instar. At emergence, the pupa is thrust through the lower epidermis (rarely the upper). Mosher (1916, figs. 54, 54a) illustrates the pupa.

Tischeria heliopsisella in wing markings is closely related to *T. ambrosiaeella* Chambers; reared specimens are easily distinguished by the mines; the male genitalia of the two are very different.

Walsingham (Proc. Ent. Soc. Lond., 1897, p. 145) records *T. heliopsisella* from the West Indies, stating "Bred . . . ., but the plant not identified." I have not included this reference under *T. heliopsisella,* as this specimen is probably not *T. heliopsisella,* but a similar species, separable by genitalia only.

(36) Tischeria ambrosiaeella Chambers

(Figs. 49, 93, 93a, 139, 139a.)

1875. *Tischeria ambrosiaeella* Chambers, Cin. Quart. Journ. Sci. II, 112. Location of type unknown.
1890. *Tischeria ambrosiella* Walsingham, Ins. Life II: 325.
1923. *Tischeria ambrosiaeella* Forbes, Mem. 68, Cornell Univ. Agric. Exp. Sta., p. 147.

Face pale clay color, tuft pale clay color, sometimes with a few fuscous scales; antennal scape pale, stalk shading to fuscous toward tip, cilia in male very long, in female short, about as long as the width of a segment and sometimes appressed. Ground color of the fore wings pale clay color, sometimes approaching whitish, with some fuscous dusting; extent of the markings, formed by streaks and spots of fuscous scales, variable and sometimes mostly obsolete; costal margin darkened to the costal cilia; almost at base of costa, a fuscous spot, connected by a diagonal line of scales with a similar spot near base of dorsum; from basal third of costa, an oblique streak, sometimes broken, sometimes forming a spot in cell, crosses the wing to a fuscous spot on middle of dorsum; from apical third of costa, a streak, broad on costa, extends toward a tornal spot, but is often broken, or connected with the tornal spot merely by a line of scattered scales; costa beyond sometimes broadly dusted, sometimes not dusted; apical area sometimes densely dusted, some-

times without dusting and then pale whitish clay colored; cilia usually distinctly roseate at apex, with a line of dark-tipped scales projecting into them. Hind wings whitish with faint clay color tinge in pale specimens, fuscous with fuscous cilia in dark, strongly marked specimens. Fore and middle legs fuscous outwardly, hind legs whitish in pale specimens, dusted with fuscous in dark specimens. Abdomen more or less dusted with fuscous.

Alar expanse 6 to 7 mm.

Male genitalia (figs. 93, 93a). Vinculum broadly rounded; harpe divided, costal area heavily sclerotized, broad at base, narrowing to the costal prongs, and above, cylindric, and at tip dividing into two oppositely directed long, acute teeth, cucullus narrow, setose; juxta triangular; anellus cylindric with lateral rows of minute setae; aedeagus bent at base, dividing above middle into two thin plates, sclerotized along inner margins, lobed along outer margins (cf. fig. 93a); socii slender, sparsely setose; forks of uncus triangular.

Female genitalia (fig. 139). Ovipositor and lateral lobes very small, peg setae few and slender; posterior apophyses slender, acute at tips; anterior margin of sex opening with median projection; anterior margin of segment 8 long produced midventrally and then forking into the slender arms of patibulum; prela long, slender to near tips, then abruptly enlarging into the curved tips, each bearing two minute spines.

Specimens examined. — 19 ♂, 21 ♀.

OHIO: Cincinnati, 3 ♂, 5 ♀, rearing record B.379, on *Ambrosia trifida* L., mines July 10, imagoes July 13 to August 6; 8 ♂, 2 ♀, flown, September, October, and November dates [AFB]; Stonelick Lake State Park, Clermont County, 2 ♂, 5 ♀, rearing record B.2385, on *Ambrosia trifida*, mines September 2, imagoes September 6 to 9 [AFB]; Cincinnati, 3 ♂, 1 ♀, rearing record B.379, "on *Ambrosia*", imagoes August 2, September 8, 1 ♂, 1 ♀, flown, September 23, September 29 [USNM].

PENNSYLVANIA: Oak Station, Allegheny County, 1 ♀, Oct. 18 [USNM].

MISSOURI: 2 ♂, 5 ♀, "From Miss Murtfeldt" [USNM].

CALIFORNIA: Compton, 1 ♀, "on *Ambrosia psilostachya*, Oct. 13, 1912" (P. H. Timberlake) [USNM].

The larvae are miners of leaves of *Ambrosia trifida* L. and *Ambrosia artemisiifolia* L. The mine is an irregular blotch, usually lying between two veins and hence elongate; the lower epidermis of the leaf is loosened. As viewed from the upper side of the leaf, all green tissue is eaten except in an oval convex area which remains green throughout the mining period (fig. 49). Beneath this is the oval whitish nidus attached to the lower epidermis of the leaf. At emergence, the pupa is thrust through the upper or lower epidermis at the beginning of the mine.

The mines are commonly found on *Ambrosia trifida,* but Chambers (1875) mentions receiving specimens and a mine from Miss Murtfeldt, reared from *Ambrosia artemisifolia* L. in Missouri. I quote his remarks: "This mine is at the edge of the leaf, while in *A. trifida* the mine occurs anywhere on the leaf; and the species from *artemisifolia* emerges *through the edge* of the leaf."

Superficially, *T. heliopsisella* and *T. ambrosiaeella* are scarcely distinguishable because of the great intraspecific variation. In perfect specimens, the roseate color of the apical cilia is a distinguishing character. The different larval habits easily separate the two species. Genitalic characters will at once identify both species.

The specimen from California, while far from the normal range, agrees in detail of markings, including the roseate cilia of apex of fore wing.

(37) **Tischeria helianthi** Frey and Boll (Figs. 51, 51a, 94, 94a, 140.)

1878. *Tischeria helianthi* Frey and Boll, Stett. Ent. Zeit. XXXIX: 258. Type, vicinity of Dallas, Texas [BM].

1890. *Tischeria helianthi* Walsingham, Ins. Life II: 324.

Face dull ocherous, pale in pale specimens, the scales of the ocherous tuft fuscous-tipped; antennal scape small, cilia of stalk in male long in basal three-fourths, very short at tip of antenna, in female very short throughout. Thorax varying in color from bright ocherous to dull ocherous and more or less fuscous dusted. Fore wings varying in color from bright, almost orange ocherous and immaculate for the basal three-fourths of the wing length (some females) to dull grayish ocherous, with brown or fuscous dusting sometimes so dense over the entire wing surface as almost to obliterate the markings (one male); in the brightest females, the dark margin along costa extends to three-fourths the wing length, there joining a costal spot, which spreads along the costa to apex, encircling it as a narrow line of brown scales, which then follows the termen to tornus, meeting a tornal dark spot, which lies almost opposite the costal spot (instead of diagonally across from it); in darker specimens, where the costal spot begins at two-thirds, the tornal spot lies diagonally across from it and is sometimes connected with it by a line of brown scales; sometimes, a brown spot on middle of dorsum, dorsal margin near base brown, a small spot in cell, or a short diagonal bar from basal third of costa; the dark margining of costa may increase in width toward base; cilia pale reddish brown to fuscous. Hind wings variable in color, pale fuscous ocherous to blackish fuscous, cilia concolorous. Legs pale ocherous to dark brown. Abdomen pale ocherous to blackish brown.

Alar expanse 6.5 to 7.5 mm.

Male genitalia (figs. 51, 51a). Vinculum broadly rounded; costal area

of harpe separated from remainder of harpe by a broad sclerotized sinus and developed into a strong and little curved tooth, which emits at about its middle, a bifid tooth; cucullus slender elongate, setose; anellus an elongate cylinder, its margins recurved and heavily sclerotized; aedeagus bulbous at base, forking at about two-thirds its length, forks rounded at tips, vesica with a single acute spine; socii elongate, a few setae at tips; forks of uncus small, triangular.

Female genitalia (fig. 140). Ovipositor lobes large, peg setae slender, lateral lobes small; sex opening transverse; posterior apophyses slender; sternite of 8 not produced, arms of patibulum well separated at origin; prela slender basally, toward tips with a large triangular membranous projection.

Specimens examined. — 9 ♂, 8 ♀.

OHIO: Anderson Township, Hamilton County, 1 ♂, 1 ♀, rearing record B.2456, on *Helianthus hirsutus* Raf., imagoes July 30 and August 1; Fort Ancient, Warren County, 1 ♂, rearing record B.1800, on *Helianthus* sp., imago August 26; near Roosevelt Lake, Scioto County, 2 ♂, 1 ♀, rearing record B.1800, mines August 12, imagoes August 14 to 26; Shawnee Forest, Scioto County, 1 ♀, rearing record B.1800 imago April 24; Shawnee Forest, Scioto County, 1 ♂, 2 ♀, rearing records B.2412 and B.2413, on *Helianthus hirsutus*, mines collected October 6, imagoes April 10 to 21 [AFB].

KENTUCKY: Near Kenton, Kenton County, 2 ♂, 1 ♀, rearing record B.1800, on *Helianthus hirsutus*, imagoes August 14; Natural Bridge State Park, Powell County, 1 ♂, rearing record B.2092, on *Helianthus* sp., mine October 18, imago April 24 [AFB].

TENNESSEE: Deal's Gap, Great Smoky Mountains National Park, 1 ♂, 2 ♀, rearing record B.2124 on *Helianthus divaricatus* L., mines October 15, imagoes April 17 (♂), April 28 (♀'s) [AFB].

ARKANSAS: Camp Hedges, Ozark National Forest, Stone County, mines collected on *Helianthus* sp., no imagoes reared.

The underside, very characteristic and somewhat tentiform mines occur on several species of *Helianthus*. The mine (figs. 51, 51a) starts in the angle between two veins, gradually broadening outward; the loosened lower epidermis of the leaf is pale; on the upper side of the leaf the mine is greenish when fresh, showing the network of veins, and a few green patches near the beginning of the mine where no green tissue is eaten. At the beginning of the mine, there is an elongate, silken-lined oval area, with lower epidermis here more wrinkled than elsewhere; extending outward from this through the middle of the mine is a loosely silken-lined runway, visible on the upper side of the leaf as a low ridge. At the time of pupation the oval area is more densely lined with silk, forming the pupal chamber in which the pupa lies with head toward the beginning of the mine.

At emergence the pupa is thrust through the lower epidermis.

In his description, Frey mentions the resemblance of the mine of *T. helianthi* to the mines of species of *Lithocolletis* as noted by Boll, who reared the type series on *Helianthus maximilliani* Schrad. There are two generations a year, mines of the first occur in midsummer with emergence of imagoes in late July and in August, mines of the second generation in October, with imagoes the following April.

The extreme variability of this species renders identification almost impossible from flown material. It is probably a common species westward, but overlooked.

(38) **Tischeria gregaria** new species

(Figs. 2, 16, 52, 52a, 95, 95a, 141.)

Face pale brownish ocherous, labial palpi large with the pair of basal spine-like setae easily visible, tuft on vertex brownish ocherous, with dark-tipped and golden brown scales intermingled, antennal scape small (fig. 2), with a narrow pointed projection of long scales and a few small scales, stalk simple in both sexes in the basal half, in the outer half in both sexes with short, stiff, almost spine-like setae, resulting in a minute bipectinate aspect. Fore wings dull gray, somewhat tinged with ocher and more or less densely dusted with blackish scales, which may sometimes tend to obscure the markings, which are sometimes obsolescent: near base on dorsum, a dark spot which may project obliquely toward a costal bar at basal third; from basal third of costa, this oblique dark bar reaches the middle of the wing, but does not meet a dark dorsal spot lying in line with it; at apical third, the more or less diffuse dusting along costa merges with a darker triangular spot; obliquely opposite this costal spot and in line with its oblique inner margin, is a dark tornal spot; apical area more or less dusted, with a line of dark-tipped scales around apex at the base of the cilia; tip of apex and apical cilia often tinged with golden brown. Hind wings and cilia fuscous, cilia at bases reddish. Figure 16 illustrates the venation typical of Section III. Legs dull ocherous, more or less shaded with fuscous, posterior tarsi usually paler. Abdomen above densely fuscous dusted, except toward tip, terminal segments in female and anal tuft in male whitish ocherous.

Alar expanse 7.5 to 8 mm.

Male genitalia (figs. 95, 95a). Vinculum broadly rounded; costal area of harpe broad at base, with a projecting lobe beyond middle, then bending inwardly and narrowing to the long sharp apex; cucullus slender, acute, setose; anellus cylindric, dorsally produced with apical sinus; aedeagus very slender anteriorly, forking at two-thirds its length, forks at middle abruptly narrowing into the long acicular tips; socii thick at origin, slender beyond middle, sparsely

setose; forks of uncus triangular, widely separated.

Female genitalia (fig. 141). Ovipositor and lateral lobes small, peg setae slender; sex opening transverse, posteriorly angled, anteriorly with pointed median projection; posterior apophyses slender; sternite of segment 8 narrowly and shortly produced midventrally and soon forking into the arms of patibulum; prelum long, with broad outward curve before the spoon-shaped tip, which presses into an elongate strongly sclerotized area of ductus bursae; enlarged section of ductus bursae with patches and rows of spinules.

Type. — ♂, near Jackson Lake Lodge, Grand Teton National Park, Wyoming, rearing record B.1448, on *Helianthella quinquenervis* (Hook.) Gray. Mine collected July 26, imago August 5, 1934 [AFB].

Allotype. — ♀, same data as the type, except date of emergence August 1 [AFB].

Paratypes. — 8 ♂, 12 ♀, same data as the type, except dates of emergence from July 29 to August 5 [AFB].

The underside mines, on leaves of *Helianthella quinquenervis* (Hook.) Gray, usually lie between the midrib and a lateral vein (figs. 52, 52a). Viewed from above, a large oval area, in which the green tissue is not eaten, retains the green color of the leaf; in the remaining irregular part of the mine, where all green tissue is eaten, the leaf epidermis on both surfaces is discolored and brown (shown stippled on the figures). Pupation takes place in the oval, silken-lined chamber, where the lower, loosened epidermis is slightly wrinkled.

At the time of collection, the larval mines were very abundant, with several mines on a single narrow leaf.

The gray ground color of the fore wings, together with characters of genitalia of both sexes, and a knowledge of the food plant identify this species.

(39) **Tischeria marginata** new species (Figs. 96, 96a, 142.)

Face whitish, head dorsally pale whitish ocherous, scales of tuft whitish centrally, laterally from faintly brownish-tipped to fuscous-tipped; antennal scape whitish ocherous, stalk brownish, with long cilia throughout in male, in female simple in basal half, minutely serrate in outer half. Fore wings pale ocherous, whitish ocherous in female toward base, with a faint orange tinge toward apex, very narrow; costa from base narrowly dark to one-third the wing length where the narrow dark margin widens into a broad stripe, widest at two-thirds (in male type) and ending before apex, thus leaving clear ground color between it and the apex; in the female allotype and female paratype,

only the extreme costal margin is dark along basal third, and in the female paratype the narrow margin does not widen before two-thirds; in this stripe the scales are pale and dark-tipped; a few dark-tipped scales in fold (lacking in the females); at base of dorsum, a small blackish dot; a similar dot just below fold at basal fourth (absent in paratype); a dark broken line of dark-tipped scales along dorsal margin from base to middle of wing length where it meets a small spot containing two or three black scales (indistinct in female paratype); at tornus, several black scales on a pale ground; apex of wing pale, a line of narrowly dark-tipped scales from costa around apex, and following termen to tornus as scattered dark scales; cilia pale ocherous on costa before apex, fuscous elsewhere. Hind wings and cilia fuscous, paler in females. Legs dull pale ocherous, shaded outwardly with fuscous.

Alar expanse 6.5 to 7 mm.

Male genitalia (figs. 96, 96a). Vinculum broadly rounded; costal area of harpe strongly sclerotized, wide in basal portion, with broadly curving costal margin, emitting near its base a short sharp tooth, then abruptly narrowing to the inwardly bent curved sharp tooth which bears near its base a short small tooth; cucullus slender, greatly exceeding the costal sclerotized area; anellus a short cylinder, emarginate on its ventral margin; aedeagus slender, slightly bulbous at base, forking at two-thirds its length into two slender acuminate prongs, acicular toward tips; socii slender, tips curved, a few setae; forks of uncus broad triangular, connate at base, separated by a V-shaped sinus.

Female genitalia (fig. 142). Ovipositor lobes larger than lateral lobes, peg setae short, thick; posterior apophyses slender; sternite of 8 produced as a broad band, then forking into the widely separated arms of patibulum; prelum with an outward curve before the narrow spoon-shaped tip which presses into a small sclerotized area of ductus bursae; enlarged portion of ductus microscopically spinulose.

Type. — ♂, "West Fork, 6500′, 16 mi. SW Flagstaff, Coconino Co., Ariz., 7 Aug. 1961" (R. W. Hodges) [USNM, Type No. 71295].

Allotype. — ♀, South Fork of Cave Creek (near Portal), Chiricahua Mts., Arizona, rearing record B.1781, "on a Composite", mine July 4, imago July 12, 1939 (A. F. Braun) [USNM].

Paratype. — ♀, same data as the allotype [AFB].

The elongate mines from which the allotype and paratype were reared lie between the midrib and the margin of the narrow leaves of the food plant; all green tissue is consumed, and the mine is about equally apparent on either surface. The larva does not construct a nidus.

The narrow fore wings and the dark markings, almost confined to the wing margins, characterize this species.

(40) Tischeria heteroterae Frey and Boll (Figs. 4, 143.)

1878. *Tischeria heteroterae* Frey and Boll, Stett. Ent. Zeit. XXXIX: 257. Type ♀, Dallas, Texas [BM].

The following is a translation of Frey's description, made from "two beautiful female specimens."

> Head ocher yellow, tuft in middle and behind bright reddish yellow, otherwise yellowish white. Thorax ocher yellow. Abdomen and legs yellowish; the first two pair much paler than in Nolckenii [heliopsisella], the hind with spotted tarsi.
>
> The ground color of the rather wide fore wings, rounded at apex [fig. 4], is the same ocher yellow, with a strong admixture of white scales, densest in the middle third of the wings and on the hind margin between the ocher yellow scales. Moreover scattered black scales lie over the whole wing expanse, and in a bow-shape over the basal part of the ocher yellow cilia. . . . . .
>
> Hind wings and cilia whitish gray.
>
> On the underside, the fore wings are pale gray, approaching yellow.

Frey states that his coworker Boll discovered the underside mines on leaves of "Heterotera scabra." The spelling of the generic name is an error as there is no plant genus *Heterotera.* The correct name of the food plant is *Heterotheca scabra* (=*Heterotheca grandiflora* Nutt.).

Female genitalia (fig. 143, drawn by a National Museum artist from a slide of the type, BM slide 15284). Peg setae of the ovipositor lobes very small; posterior apophyses slender; sternite of 8 with a long median parallel-sided production, forking into the short arms of patibulum; prela enlarged at tips; ductus bursae spinulose.

The figure of the wings was drawn by the writer from a photograph of the type supplied through the courtesy of the British Museum. Through the kindness of Dr. Donald R. Davis, who made the slide of the type, I am able to figure the female genitalia.

The knowledge of the food plant and mine should aid in rediscovery of this species.

(41) Tischeria longe-ciliata Frey and Boll

1878. *Tischeria longe-ciliata* Frey and Boll, Stett. Ent. Zeit. XXXIX: 259. Type ♂ (without abdomen), Dallas, Texas [BM].

The following is a translation of Frey's description.

Face and palpi ocher brown, the former faintly shining. Tuft bright ocher yellow. Antennae brownish white with extraordinarily long pale cilia. Thorax of the ground color of the fore wings; legs brownish gray; abdomen dark gray.

Fore wings rather lusterless, ground color a bright ocher brown, broken with a few white scales. The whole costa is margined with dark brown scales, as is also the apex. Similar scales are scattered in the cilia. At the hind angle a dense dark accumulation of scales is connected with a similar wider spot extending from costa. Another small collection lies on dorsal margin toward base, just before half the wing length.

Cilia of the apex light ocher brown, of the hind angle pale gray.

Hind wings pale gray. Cilia paler, without yellowish tinge.

The underside of the fore wings appears dark gray, with yellowish apex.

Frey described the species from a single male, reared by Boll from mines in leaves of *Helianthus* sp. No description of the mine is included, and this lack, in addition to the loss of the abdomen of the male type, will render identification of the species uncertain.

Frey notes that *longe-ciliata* is larger than *nolckenii* (*heliopsisella*) and with narrow wings.

(42) Tischeria pallidipennella new species (Figs. 97, 97a.)

Face white, head white, scales of tuft very faintly tinged with gray toward tips; antennal stalk pale gray, with long dense white cilia in basal half, in outer half cilia somewhat shorter and less dense. Fore wings creamy white, and in the apical third faintly pinkish tinged; a sparse scattering of very pale gray-tipped scales (most apparent in the paratype) so pale as not perceptively to darken the wing; at apical third an indistinct costal spot, formed of a group of the gray-tipped scales, and diagonally across from it, a larger darker spot, with scales more broadly dark gray-tipped, lies over the fold, and is separated from the wing margin by a few pale scales; dark gray-tipped scales form a well-defined patch in the apex of the wing, preceded on costa by a few gray-tipped scales; the dark tips of projecting pale scales form a line curving through the middle of the pinkish apical cilia; toward tornus, cilia pale whitish gray. Hind wings and cilia pale gray, cilia white at bases. Legs white, shaded with gray, hairs of the hind tibiae white. Abdomen gray.

Alar expanse 7.5 to 7.8 mm.

Male genitalia (figs. 97, 97a). Vinculum broadly rounded, its anterior margin nearly a half circle; entire costa of harpe sclerotized, the sclerotized area widening toward base and just above the costal prongs produced as a short sharp tooth; cucullus with strong dark setae; anellus cylindric, its dorsal half long produced and with a deep sinus apically, bearing on each side a single seta; aedeagus short, with a large bulbous base, and broad, thin forks;

socii very long, much exceeding the short, triangular, and approximate uncus forks.

Female unknown.

Type. — ♂, Madera Canyon, Santa Rita Mountains, Arizona, Aug. 9, 1959 (R. W. Hodges) [USNM, Type No. 71296].

Paratype. — ♂, Pena Blanca Canyon, Santa Cruz Co., Arizona, Aug. 26, 1959 (R. W. Hodges) [USNM].

A very distinct species, differing from all other known species of our fauna, and easily recognizable. The male genitalia are distinctive, and unlike those of all other species.

Section IV

Species 43 to 46

The four species included in the section are miners of leaves of *Ceanothus* spp. (Rhamnaceae). Three of the species are gray, the scales white-tipped, producing an irrorate aspect; a darker tornal spot may be present. The ground color of the fourth species is pale yellow, with shades of deep yellow or orange. In the species of this section, R_3 is absent in the fore wing (figs. 11, 12). As in Section III, the abdominal setae of the pupae are short and not forked at the ends. The male genitalia exhibit extreme specialization and diverge widely from the typical form. Three of the species (*ceanothi, immaculata,* and *ambigua* (figs. 98, 99, 100) agree in the slender harpe, almost rod-like in *immaculata* and *ambigua,* and similar elaborate anellus and aedeagus. The female genitalia of these species agree in the transversely elongate lateral lobes and the apically forked prelum; the sternite of segment 8 is prolonged posteriorly into a sharp point. The male genitalia of the fourth species (*bifurcata,* fig. 101) show but slight similarity to the genitalia of the other three species. A very different harpe, an elaborate, though very different anellus, the aedeagus forking into two flattened, ellipsoidal pointed plates distinguish this species. The female genitalia of this species conform more nearly to the typical form, but exhibit the long pointed posterior projection of the sternite of segment 8.

Key to the Species of Section IV

Based on Coloration and Markings

1. Fore wings some shade of yellow, orange yellow or ocherous .....

..... (46) *bifurcata*
Fore wings gray 2
2. Fore wings evenly and finely irrorate ..... (44) *immaculata*
Fore wings not evenly irrorate; darker spots present 3
3. Wing with clouded aspect; scales of scape very long; expanse 10 to 11 mm
..... (45) *ambigua*
Wing irregularly irrorate; scales of scape not long; expanse 6 to 7 mm ....
..... (43) *ceanothi*

Key to the Species of Section IV
Based on Genitalic Characters

A. Male genitalia

1. Aedeagus forking near base into two flattened ellipsoidal plates, anellus with long tapering tubular outgrowths ..... (46) *bifurcata*
Aedeagus forking near base into two slender forks, each incised near apex, and at apex dividing into two narrow lobes; anellus with two hand-like processes 2
2. Harpe long and slender; forks of uncus sloping to the median membrane 3
Harpe elongate, but not unusually slender; vinculum abnormally large, its anterior ventral margin sinuate; forks of uncus widely separated ....
..... (43) *ceanothi*
3. Harpe almost rod-like, a series of short, stiff setae at apex, costal prongs long ..... (45) *ambigua*
Harpe not as long and rod-like, costal prongs short and curved .....
..... (44) *immaculata*

B. Female genitalia (*ambigua* omitted); sternite of segment 8 produced posteriorly into a sharp point

1. Lateral lobes of segment 9 transversely elongate and bearing long, heavy, spine-like setae; prela forked at tips 2
Lateral lobes of the normal rounded shape, setae slender; prela slender, acute ..... (46) *bifurcata*
2. Peg setae of ovipositor lobes black and curved at tip, not crowded together ..... (43) *ceanothi*
Peg setae of ovipositor lobes small and crowded together .....
..... (44) *immaculata*

(43) **Tischeria ceanothi** Walsingham

(Figs. 12, 57, 57a, 98, 98a, 144.)

1890. *Tischeria ceanothi* Walsingham, Ins. Life II: 325. Types ♂, ♀, Mendocino County, California [BM].
1915. *Tischeria ceanothi* Braun, Ent. News XXVI: 272.

Face whitish; forward projecting scales of tuft whitish, tuft posteriorly gray with slight brownish tinge; antennae of male long ciliate, of female simple. Fore wings clothed with white-tipped gray scales, but with a general faint brownish tinge, irregularly and coarsely irrorate, sometimes a little paler below fold; an indistinct darker spot at tornus; rarely a slight accumulation of darker scales at end of cell and at apex; cilia gray. Melanistic forms occur in which most of the scales are so narrowly white-tipped as to render the wing blackish gray over most of the surface; in such specimens the hind wings are dark gray. Hind wings typically pale gray to grayish white, cilia with faint brownish tinge. Legs pale gray, more or less dark gray or blackish shaded. Abdomen gray, anal tuft grayish ocherous.

Alar expanse 6 to 7 mm (rarely greater).

Male genitalia (figs. 98, 98a). Vinculum huge, approaching the tegumen in anterior-posterior extent, its anterior margin sinuate, posterior margin convex, slightly sinuate, anterior margin of tegumen straight; harpes elongate, slightly expanding toward apex, setose above the middle, articulating in mid-length with vinculum by sharp curved teeth, and greatly produced anteriorly to the transtilla, then narrowing as costal prongs; anellus (fig. 98a) complex, with lateral hand-like processes, and produced dorsally into two broad lobes, with a deep sinus between them; aedeagus (fig. 98a) dorso-ventrally flattened at base, and near base dividing into the two forks, each inwardly incised near tip, and at tip, forking into two narrow lobes; forks of uncus widely separated, long, slender, their tips curved ventrad. The specialized scales of the lateral tufts of segment 8 very long.

Female genitalia (fig. 144). Peg setae of ovipositor lobes black and curved at tips; lateral lobes transversely elongate, setae long, spine-like; sex opening circular; posterior apophyses enlarged at tips; sternite of segment 8 produced posteriorly into a long sharp point, anteriorly dividing into the widely separated arms of patibulum; prela short, slender, bifurcate at tips; enlarged portion of ductus bursae minutely spinulose, a sinuate band of spinules.

Specimens examined. — 21 ♂, 14 ♀, 68, ♂,♀, sex not determined.

CALIFORNIA: Dutch Flat, Placer County, 11 ♂, 4 ♀, rearing record B.423, on *Ceanothus divaricatus* Nutt., mines collected in February, imagoes in March [AFB]; 6 ♂, 5 ♀, several bearing rearing record B.423 [USNM]; Placer County, 1 ♀, "larva on *Ceanothus integerrimus* Hook. & Arn.", 1 ♂, annotated by Walsingham [USNM]; Eureka, Humboldt County, 1 ♂, 1 ♀, "on Myrtle, H. S. Barber, iss. June 24, 1903" [USNM]; Arcata, Humboldt County, 32, ♂, ♀, on *Ceanothus thyrsiflorus* Esch. accompanied by a number of mines, typical of the species, June 30, 1969 (J. Powell) [UCB]; Sequoia National Park, 1 ♂, 2 ♀, rearing record B.2254, on *Ceanothus* sp., mines collected July 19, imagoes July 22 [AFB]; Fredalba, San Bernardino County, 1 ♂, 1 ♀, rearing record B.423a, on *Ceanothus* sp., mines collected in early August, imagoes August 28 and 31 [AFB]; additional California records from

Siskiyou, Contra Costa, Tuolumne, Kern, Tulare, and Mono counties, 19, ♂, ♀, one to several from each county.

NEVADA: Daggett Pass, Douglas County, 7300′, 27, ♂, ♀, on *Ceanothus velutinus* Douglas, mines collected May 17, imagoes June 2, 1969 (J. Powell 69E94) [UCB].

The larvae are miners in leaves of a number of species of *Ceanothus*. The mines are especially common on *Ceanothus divaricatus* Nutt., a single leaf sometimes containing several mines. Figures 57, 57a (twice natural size) illustrate the work of the larvae in leaves of this species. The narrow linear mine gradually increases in breadth, then expands into a blotch, which may include some of the earlier portion; a black line of frass, gradually increasing in width, extends through the middle of the linear mine; the blotch is rather evenly mottled with grayish groups of these particles. There are three and possibly four generations in a year.

"Myrtle", recorded as the food plant of a pair of specimens from Eureka, Humboldt County, is *Ceanothus thyrsiflorus* ("Blue Myrtle").

The faint brownish tinge of the fore wings separates *T. ceanothi* from the following two related species. The unusual character of anellus and aedeagus is common to the three species; differences in the harpes and vinculum separate these species.

(44) Tischeria immaculata Braun (Figs. 54, 99, 145.)

1915. *Tischeria immaculata* Braun, Ent. News XXVI: 271. Type ♂, Loma Linda, San Bernardino County, California [AFB].

Face pale gray, forward projecting scales of tuft broadly white-tipped; antennae in male long ciliate, in female simple. Scales of the fore wing very small, each minutely white-tipped, producing a finely and uniformly irrorate aspect over the entire wing surface except that there may be a slight accumulation of darker scales at the end of cell; cilia gray. Hind wings and cilia gray. Legs gray, scales white-tipped, hind tibiae and tarsi yellowish white. Abdomen gray beneath, yellowish shaded with gray above, anal tuft yellowish.

Alar expanse 7.5 to 8 mm.

Male genitalia (fig. 99). Vinculum anteriorly right-angled; harpes very slender elongate, only slightly enlarging apically, articulating below basal third with vinculum by scarcely defined teeth, then swollen to the short transtilla, and abruptly narrowing to the short curved costal prongs; anellus and aedeagus as in *ceanothi* (fig. 98a); forks of uncus curved, acute (viewed laterally), sclerotized area between them emarginate.

Female genitalia (fig. 145). Ovipositor lobes oblique, elongate, peg setae small, crowded; lateral lobes linear, each with a single row of long, heavy marginal setae; sex opening circular; posterior apophyses expanded at tips; strongly sclerotized area of sternite of segment 8 reduced to a narrow band, posteriorly produced into a long sharp point, and laterally continuous with the widely separated arms of patibulum; prelum short, at tip dividing into two unequal curved arms; enlarged portion of ductus bursae minutely spinulose, a sinuate band of spinules.

Specimens examined. — 6 ♂, 6 ♀.

CALIFORNIA: Loma Linda, San Bernardino County, ♂ type, rearing record B.743, on *Ceanothus crassifolius*, mine collected in April, imago April 29, 1913, genitalia slide 895 A.F.B. [AFB]; 5 ♂, 6 ♀, paratypes, same data as the type, except dates of emergence April 28 to May 3 [AFB].

The larvae are miners in the thick, spiny-edged leaves of *Ceanothus crassifolius* Torr. Through the middle of the elongate mine (fig. 54) the loosened upper epidermis is raised above the general surface of the leaf as a low ridge. At emergence, the pupa is thrust through the lower epidermis.

The mines from which the type series was reared were collected in April by G. R. Pilate, from whom in the past I received much material in the mining stage.

In the original description, the food plant was erroneously identified as *Prunus ilicifolia* Walp.

The minutely and uniformly irrorate aspect of the fore wings separates *T. immaculata* from both *T. ceanothi* and *T. ambigua*. The length of the harpes, abruptly narrowing to the short costal prongs, likewise differentiate *T. immaculata* from both.

(45) Tischeria ambigua Braun (Figs. 56, 100.)

1915. *Tischeria ambigua* Braun, Ent. News XXVI: 272. Type ♂, Fredalba, San Bernardino County, California [AFB].

Face and labial palpi dark gray, forward projecting scales of tuft white-tipped, antennae dark gray, scales of scape very long, twice the length of the segment, and conspicuously projecting, shaft long ciliate in male. Fore wings gray, coarsely scaled toward apex, the scales white-tipped, but irregularly so, resulting in a clouded aspect, the surface therefore not evenly irrorate; the wing is somewhat darker along costa and fold; a transverse irregular blackish spot near tornus, sometimes reaching half-way across the wing; cilia at apex dark gray, shading to pale gray at tornus. Hind wings and cilia pale gray, with a faint reddish ocherous tinge. Fore and middle legs dark gray, hind legs yellowish, tarsal segments dark-tipped. Abdomen gray, shading to the

yellowish gray anal tuft.

Alar expanse 10.5 to 11 mm.

Male genitalia (fig. 100). Vinculum obtusely angled; harpes very long and slender, almost rod-like, scarcely enlarging at apex, setose only near apex and with a series of short stiff setae at apex; articulating with vinculum at their basal fourth and not greatly swollen before the long slender costal prongs; anellus and aedeagus as in *ceanothi* (fig. 98a); forks of uncus long, not widely separated, a shallow sinus between them.

Female unknown.

Specimens examined. — 3 ♂.

CALIFORNIA: Fredalba, San Bernardino County, ♂ type, rearing record B.733, on *Ceanothus oliganthus* Nutt., imago August 29, 1912; 2 ♂ paratypes, same data as the type, dates of emergence August 24, August 29 [AFB].

In addition to the three males of the type series, two males in poor condition, with crumpled wings, were reared from the same lot of mines.

The larvae are miners in the small, thick, and leathery leaves of *Ceanothus oliganthus* Nutt. The mine (fig. 56, twice natural size) starts on the upper side of the leaf as a short linear tract perpendicular to the midrib, then bending sharply, expands into a short elongate blotch, in which the loosened upper epidermis of the leaf is drawn into a series of diverging ridges, which extend to the outer limits of the mine. When fresh, the mine is deep yellow in color. The pupa projects from the lower epidermis at emergence.

Mines were collected by G. R. Pilate, and received August 24, 1912.

The mine, with the numerous ridges in the loosened epidermis of the leaf, separates this species from the allied *T. ceanothi* and *T. immaculata.* The marbled aspect of the fore wing is characteristic. The wing expanse is greater than that of either of the allied species. The extremely long harpe, almost rod-like in shape, is a further diagnostic character.

(46) Tischeria bifurcata Braun (Figs. 11, 55, 55a, 101, 146.)

1915. *Tischeria bifurcata* Braun, Ent. News XXVI: 273. Type ♂, allotype ♀, Fredalba, San Bernardino County, California [AFB].

Face, palpi, tuft and antennae whitish yellow, or, sometimes tuft darker yellow, with brownish scales posteriorly, antennal scape whitish, shaft gray; shaft in male with long cilia, in female simple. Coloration of fore wings extremely variable; the wings may be very pale yellow at base shading

gradually to deeper yellow or orange toward apex, or, the darker orange yellow of the apical area may be sharply separated from the pale yellow color, or, the entire wing may be almost uniformly dull ocherous, but usually darker, somewhat brownish toward apex, and often rather densely dusted with brown-tipped scales, and with an accumulation of darker scales at apex; in specimens where the apical area is sharply separated from the paler basal two-thirds, there is, on costa, just beyond middle, an elongate patch of darker scales; base of costa fuscous, and sometimes a streak of scattered fuscous scales along costa to middle of wing; in pale specimens, there may be a sparse scattering of darker-tipped scales; cilia at apex concolorous with wing, whitish toward tornus. Hind wings white, cilia faintly ocherous tinged (in type series and Arizona specimens), pale reddish gray (in the uniformly dull ocherous and dusted series). Legs yellowish white or brownish tinted, fore pair shaded with fuscous, tarsi whitish. Abdomen fuscous dusted, above and below.

Alar expanse 7 to 8.5 mm.

Male genitalia (fig. 101). Vinculum tapering to the rounded apex; harpe indistinctly divided near tip, cucullus slender, rounded at tip, ventral arm of harpe (prolongation of sacculus) acute, beaked and curving mesad, margins setose; anellus broad, tapering at base to a ring, emarginate on ventral margin, with a few minute setae, dorsally produced and sinuate, laterally with a pair of curved sharp teeth, ventrally, a pair of long tubular outgrowths, tapering to acicular tips; aedeagus dividing near base into two flattened ellipsoid plates, each contracting to the sharp pointed pyramidal apex; forks of uncus long, slender, each with several long setae, membrane between the forks with a deep narrow sinus.

Female genitalia (fig. 146). Female genitalia typical, ovipositor and lateral lobes rounded, peg setae well separated, setae of lateral lobes long and slender; sex opening sclerotized posteriorly; posterior apophyses gradually enlarging to tips; anterior apophyses expanded at tips; sternite of segment 8 not reduced, produced posteriorly into a long sharp point, anteriorly dividing into the arms of patibulum; prela slender, acute.

Specimens examined. — 17 ♂, 14 ♀, 85 ♂, ♀.

CALIFORNIA: Fredalba, San Bernardino County, ♂ type, ♀ allotype, rearing record B.732, on *Ceanothus* sp., imagoes August 31 and September 2, 1912, 6 ♂, 5 ♀ paratypes, same data as the type and allotype [AFB]; 2 ♀ paratypes, same data [USNM]; Westwood Hills, Los Angeles County, 1 ♂ [AFB], 3 ♂, 6 ♀, April, (R. M. Bohart) [UCDavis]; Eagle Canyon, Santa Cruz Island, Santa Barbara County, 85 ♂, ♀, reared on *Ceanothus arboreus* Greene, mines collected March 16, imagoes in late March and early April (J. Powell 69C51) [UCB].

ARIZONA: S. Fork Cave Creek, Chiricahua Mountains, 5 ♂, 3 ♀, rearing record B.1771, on *Ceanothus* sp., mines collected July 4, imagoes July 8 to July 10 [AFB].

The larvae mine leaves of several species of *Ceanothus,* principally deciduous species. Typically, the mine begins as a linear tract (figs. 55, 55a) curving upward and meeting the midrib of the leaf near its apex, then following the midrib toward the base of the leaf, where it branches to either side, enlarging irregularly; here, the leaf tissue is in great part consumed and the mine translucent, with scattered frass throughout. The linear part of the mine is lined with silk and the lower epidermis projects as a ridge on the underside of the leaf, forming a tube into which the larva retreats when disturbed. These different sections of the mine (as described and illustrated) are not always as clearly defined; some sections may be obliterated by more irregular mining (for example, the mines on *Ceanothus arboreus*). Pupation takes place in that part of the tube which lies over the midrib; the pupa is thrust through the lower epidermis on emergence.

There seem to be several distinct races of *T. bifurcata,* the moths so different in aspect and size as to suggest different species. However, genitalia slides were made from the type series, from the Arizona series, from the Los Angeles County series, and the series reared on *Ceanothus arboreus;* the genitalia of both sexes are identical in all. The type series and the Arizona series are the smallest, with wing expanse a scant 7 mm, most of the *Ceanothus arboreus* miners and the Los Angeles County series measure from 8 to 8.5 mm in wing expanse. With few exceptions, in the type series and the Arizona series the fore wings are pale at base gradually shading to deeper yellow or orange toward apex; in the Los Angeles County series, the darker apical area is sharply separated from the paler basal area; in all of the Santa Cruz Island specimens, reared on *Ceanothus arboreus,* the wings are uniformly dull ocherous and brownish toward apex, with a greater degree of dark dusting than in either of the other two races.

Section V

Species 47 to 49

The species included in this section are, in-so-far as known, miners of leaves of species of Malvaceae; only *omissa* has been reared. The fore wings are dull whitish with fuscous dusting, or

dull yellowish white or straw-colored dusted with grayish scales, which may form definite patches and oblique markings. The male genitalia are characterized by the slender, thin, almost membranous harpes, the parallel-sided long forks of aedeagus, curving at tips, the conspicuous socii, each with two unequal forks, and the small forks of uncus. The female genitalia of the two species figured have no resemblance to any other species included in the genus. The ovipositor lobes are modified into two curved hooks, directed ventrad, and the peg setae are reduced to rounded tubercles or are obsolete; the posterior apophyses curve above the ovipositor lobes, forming a tuberculate hood.

Tischeria pulvella Chambers is tentatively included in this section on the basis of the even dark dusting of the fore wing.

(47) Tischeria omissa Braun (Figs. 18, 102, 103.)

1927. *Tischeria omissa* Braun, Trans. Amer. Ent. Soc. LIII: 197. Type ♂, Berkeley, California [AFB].

Face varying from whitish straw-color to gray (darkest in some males); tuft whitish to gray; antennae gray, ciliations in male long at base, shorter toward tip. R_4 and R_5 coincident in the fore wing (fig. 18). Fore wings varying from whitish straw-colored to gray when dense dark dusting nearly obscures the pale ground color; the apical area and apical cilia pinkish or pinkish orange tinged, this color most evident in pale undusted specimens; the wings may be without general dusting over the wing surface, and blue-gray scales may cluster to form definite markings; in dusted specimens, the scales forming these markings are darker; the costa is dark to beyond middle; all or some of the following dark markings formed by the blue-gray or gray scales may be present; a small spot near base within the costal margin which may blend with the widened dark margin along costa, a small spot on fold near base, an obliquely placed patch within the costal margin at one-third, and in line with it, but separated from it, a similar patch just beyond middle of dorsum, three more or less connected irregular patches lying obliquely in a line from beyond middle of costa to tornus, an irregular spot, variable in size, at apex; dark-tipped scales curve through the cilia around apex. In the palest specimens, there may be merely a suggestion of the grouping of darker scales which form the markings. Hind wings varying from grayish white with reddish tinted cilia to dark gray. Legs shaded with dark gray, hind tarsi paler, but shaded with gray toward tips. Abdomen dark gray.

Alar expanse 8 to 11 mm.

Male genitalia (fig. 102). Vinculum triangular, sides meeting at a 60° rounded angle; harpes with short scattered setae, very thin, membranous,

slender, almost parallel-sided, somewhat swollen at base just distad of the costal prongs; transtilla weak in middle (not visible in lateral view); anellus a truncated pyramid, dorsal margin with sinus, ventral margin with two slender projecting sclerotized thickenings, two long lateral rods extending far beyond the margin, each ending in an oval flattened pad, two forked filaments arising from the dorsal side; aedeagus forking at mid-length, forks gradually narrowing to the acute apices; socii dividing into two unequal curved lobes; forks of uncus short, widely separated, bearing three long setae.

Female genitalia (fig. 103, lateral view). Genitalia widely diverging from the typical form; each posterior apophysis originating ventrally in a sharp point, thence curving posteriorly and dorsad; along these loops the membrane densely tuberculate; ventrally they overhang the ovipositor lobes, peg setae reduced to rounded tubercles; lateral lobes absent; arms of patibulum arising from the elongate sternite of segment 8; prela arising near the posterior margin of the membranous half of segment 8, very slender, scarcely more than filaments.

Specimens examined. — 29 ♂, 24 ♀.

CALIFORNIA: Berkeley, ♂ type, rearing record B.1242, on hollyhock (*Althaea rosea* Cav.), imago May 1, 1925; 7 ♂, 4 ♀ paratypes, same data as the type, except dates of emergence from May 1 to May 10; 2 ♂, 1 ♀, "on hollyhock", imagoes October 20, 1924 [AFB]; Berkeley, 1 ♂, 1 ♀, reared from hollyhock, Aug. 23, Aug. 24 (W. W. Jones) [USNM]; Walnut Creek, Contra Costa County, 2 ♂, 1 ♀, Oct. 23, Oct. 27 [UCB]; Nr. Woodlawn, Yolo County, 4 ♂, 5 ♀, reared from *Sida hederacea*, imagoes Oct. 10 to Oct. 14 [UCB]; nr. Vacaville, Solano County, 2 ♂, 2 ♀, reared from *Sida hederacea*, imagoes Oct. 18 to Nov. 16 [UCB]; nr. Lakeside, San Diego County, 1 ♂, 1 ♀, reared from *Sphaeralcea*, imagoes April 4, April 5 [UCB]; Davis, Yolo County, 4 ♂, 4 ♀, reared from hollyhock, imagoes Aug. 4, 1952 (W. H. Lange) [USNM]; Loma Linda, San Bernardino County, 1 ♂, February 17 (G. R. Pilate) [AFB].

ARIZONA: Nogales, 1 ♂, 4 ♀, "hollyhock, 21 July, 1945" [USNM].

TEXAS: Presidio, 4 ♂, 2 ♀, "Ex Sphaeralcea, Oct. 18, 1939, J. R. Russell" [USNM].

The larvae are miners in the leaves of the cultivated hollyhock (*Althaea rosea* Cav.), and in the leaves of *Sphaeralcea* sp. and *Sida hederacea* (Dougl.) Torr. The mine is a whitish, translucent blotch, pupation takes place in a small, wrinkled, silken-lined chamber. In the leaves of hollyhock, the mines occur in great numbers. There are several generations in a year; among the material examined, imagoes emerged in February, April, May, August, and October, rarely in November.

The original food plant is in some doubt. Dr. Jerry A. Powell, referring to *T. omissa* reared on *Sphaeralcea* in southern California,

writes:

> "I believe that probably this and / or *Malacothamnus*, a perennial shrub of southern California, are the native hosts of this species. Certainly in the places where I reared it from *Sida hederacea* the moth was utilizing a weed outside of its normal distribution. This plant was originally restricted to alkaline situations in the deserts and has moved through the central, arid part of the state along roadsides. . . . . I imagine that the *Tischeria* was native on some of the above-mentioned Malvaceae and jumped onto the *Sida* when it became available in this part of the state."

Genitalia slides, both male and female, have been made from specimens on *Sphaeralcea* and *Sida,* as well as from specimens of the type series on hollyhock, and confirm their identity.

Amongst the reared series, moths reared from hollyhock considerably surpass in size those reared on *Sphaeralcea* and *Sida.*

(48) Tischeria explosa Braun (Figs. 104, 105.)

1923. *Tischeria explosa* Braun, Trans. Amer. Ent. Soc. XLIX: 126. Type ♂, Palm Springs, Riverside County, California [AFB].

Face, palpi, and scales of the tuft grayish white, antennae grayish white, darker toward tips, cilia of antennal shaft long in male, short in female, about one-half the length of the cilia in the male. Fore wings dull sordid white, with pale brownish gray scales sparsely scattered over the entire wing surface, and a somewhat denser accumulation of such scales at the end of cell; cilia whitish. Hind wings pale whitish gray, cilia with faint ocherous tinge. Fore legs gray, middle and hind legs whitish, with faint darker dusting. Abdomen gray, anal tuft white.

Alar expanse 6 to 7 mm.

Male genitalia (fig. 104). Vinculum truncate anteriorly; harpes slender, narrow and almost parallel-sided, densely setose in apical quarter; transtilla reduced to short spurs at base of costa of harpe; anellus articulating with vinculum, its ventral anterior margin spined, its dorsal posterior margin produced beyond the ventral margin; aedeagus bulbous at base, forking above middle, each fork outwardly curved and ending in a sharp point; socii divided, a triangular lobe and a longer elongate lobe; forks of uncus widely separated, curved, acute.

Female genitalia (fig. 105, ventral view). Ovipositor lobes elongate, terminating in a black peg-like tip curving ventrad as a hook; lateral lobes may be represented by elongate sparsely setose structures, the sex opening anterior to them; posterior apophyses very long; at origin projecting beyond ovipositor, curving and forming a hood over ovipositor; anterior apophyses

slender, arising beyond ovipositor; sternite of segment 8 truncate posteriorly, lateral margins heavily sclerotized and continuous with the short arms of patibulum; prela slender, almost thread-like.

Specimens examined. — 5 ♂, 2 ♀.

CALIFORNIA: Palm Springs, ♂ type, 3 ♂, 2 ♀ paratypes, March 26, 1917, collected by G. R. Pilate [AFB]; 1 ♂ paratype, same data [ANSP].

Food plant and larval habits unknown. *T. explosa* is placed in this section on the basis of the similarity of the female genitalia to the genitalia of *T. omissa*; it is probably also a Malvaceous feeder.

In general aspect, *T. explosa* resembles *T. pulvella* Chambers, described from Texas; it is however a narrower winged species, somewhat smaller than that species and less densly dusted.

(49) Tischeria pulvella Chambers

1878. *Tischeria pulvella* Chambers, Bull. Geol. and Geog. Surv. Terr. IV: 99. Type, Bosque County, Texas [MCZ].

Following is Chambers' description of this species, known only from the unique type in the Museum of Comparative Zoology: —

"Antennae pale ochreous; vertex whitish, stained with ochreous; face and palpi white; thorax and fore wings white, suffused with pale ochreous, and *densely* dusted with ochreous-fuscous, paler and less dusted beneath the fold; hind wings and cilia pale lead-color; under surface of fore wings ochreo-fuscous, that of the hind wings whitish; both wings wide for this genus. Abdomen whitish, dusted with fuscous; anal tuft yellowish-silvery; legs yellowish white. *Alar expansion* four lines. Texas."

In the absence of any knowledge of the food plant or larval habits, *T. pulvella* is only tentatively placed in this section; its similarity to *T. explosa* suggested this placement. It is broader-winged and of greater expanse than that species, and is evenly and more densely dusted.

Chambers merely gave "Texas" for a locality; it is probably Bosque County, as given for a number of other Texas species described in the same article.

List of the North American Species of Tischeriidae

(Synonyms in italics)

Tischeria Zeller
Evexia Gistl
Philodoxa Gistl
Coptotriche Walsingham
Tisheria Busck

1. citrinipennella Clemens
   quercitella Frey and Boll (not Clemens)
   quercivorella Chambers
2. mediostriata Braun
3. consanguinea new species
4. badiiella Chambers
   citrinipennella Stainton (not Clemens)
   nubila Braun
5. lucida new species
6. distincta new species
7. subnubila new species
8. concolor Zeller
9. simulata new species
10. purinosella Chambers
    pruinosella Chambers
    albostraminea Walsingham
11. discreta new species
12. arizonica new species
13. clemensella Chambers
    zelleriella Chambers (not Clemens)
    bicolor Frey and Boll
14. fuscomarginella Chambers
15. castaneaeella Chambers
    castanella Walsingham
    cinerotunicella Braun
16. perplexa new species
17. sulphurea Frey and Boll
18. zelleriella Clemens
    complanoides Frey and Boll
    latipennella Chambers
19. quercitella Clemens
    tinctoriella Chambers
20. elongata Walsingham
21. malifoliella Clemens
22. crataegifoliae new species
23. roseticola Frey and Boll
24. agrimoniella new species
25. aenea Frey and Boll
26. splendida new species
27. insolita new species
28. confusa new species
29. inexpectata new species
30. amelanchieris new species
31. admirabilis Braun
32. solidaginifoliella Clemens
33. astericola new species
34. occidentalis new species
35. heliopsisella Chambers
    nolckenii Frey and Boll
36. ambrosiaeella Chambers
37. helianthi Frey and Boll
38. gregaria new species
39. marginata new species
40. heteroterae Frey and Boll
41. longe-ciliata Frey and Boll
42. pallidipennella new species
43. ceanothi Walsingham
44. immaculata Braun
45. ambigua Braun
46. bifurcata Braun
47. omissa Braun
48. explosa Braun
49. pulvella Chambers

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Plate I

Fig. 1. — *Tischeria citrinipennella* Clemens, lateral view of head of male. Jennings County, Indiana.

Fig. 2. — *Tischeria gregaria* new species, paratype, lateral view of head of female. Grand Teton National Park, Wyoming.

Fig. 3. — *Tischeria agrimoniella* new species, paratype, dorsal view of head of female. Fort Hill State Memorial, Highland County, Ohio.

Fig. 4. — *Tischeria heteroterae* Frey and Boll, right pair of wings from photograph of Type (BM). Dallas, Texas.

Fig. 5. — *Tischeria sulphurea* Frey and Boll, venation and cilia of hind wing of male. Washington, D. C.

Fig. 6. — *Tischeria zelleriella* Clemens, venation of right pair of wings with cilia of hind wing of male; 6a, venation and shape of hind wing of female. Cincinnati, Ohio.

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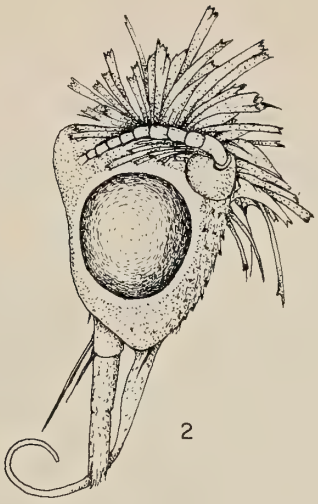

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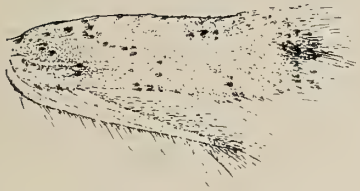

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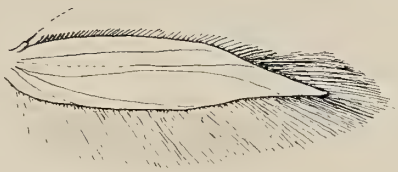

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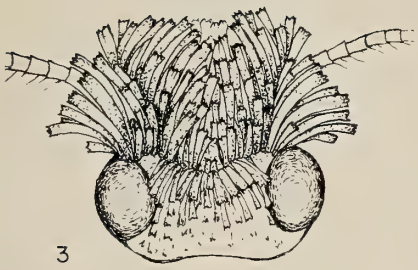

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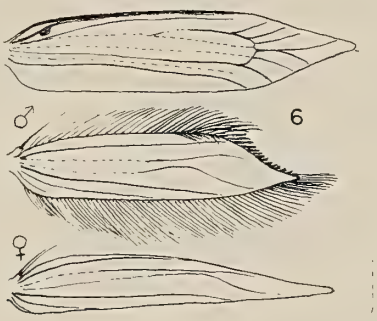

6

6a

Plate II
Venation

Fig. 7. — *Tischeria citrinipennella* Clemens, male. Cincinnati, Ohio.

Fig. 8. — *Tischeria purinosella* Chambers, female. Cincinnati, Ohio.

Fig. 9. — *Tischeria quercitella* Clemens, male. Cincinnati, Ohio.

Fig. 10. — *Tischeria clemensella* Chambers, hind wings of male and female. Devil's Den State Park, Washington County, Arkansas.

Fig. 11. — *Tischeria bifurcata* Braun, male. Chiricahua Mountains, Arizona.

Fig. 12. — *Tischeria ceanothi* Walsingham, fore wing of male. Dutch Flat, Placer County, California.

Fig. 13. — *Tischeria malifoliella* Clemens, male. Clermont County, Ohio.

Fig. 14. — *Tischeria agrimoniella* new species, male. Fort Hill State Memorial, Highland County, Ohio.

Fig. 15. — *Tischeria admirabilis* Braun, male. Cedar Falls, Adams County, Ohio.

Fig. 16. — *Tischeria gregaria* new species, paratype, male. Grand Teton National Park, Wyoming.

Fig. 17. — *Tischeria astericola* new species, paratype, male. Cheyboygan County, Michigan.

Fig. 18. — *Tischeria omissa* Braun, female. Davis, California.

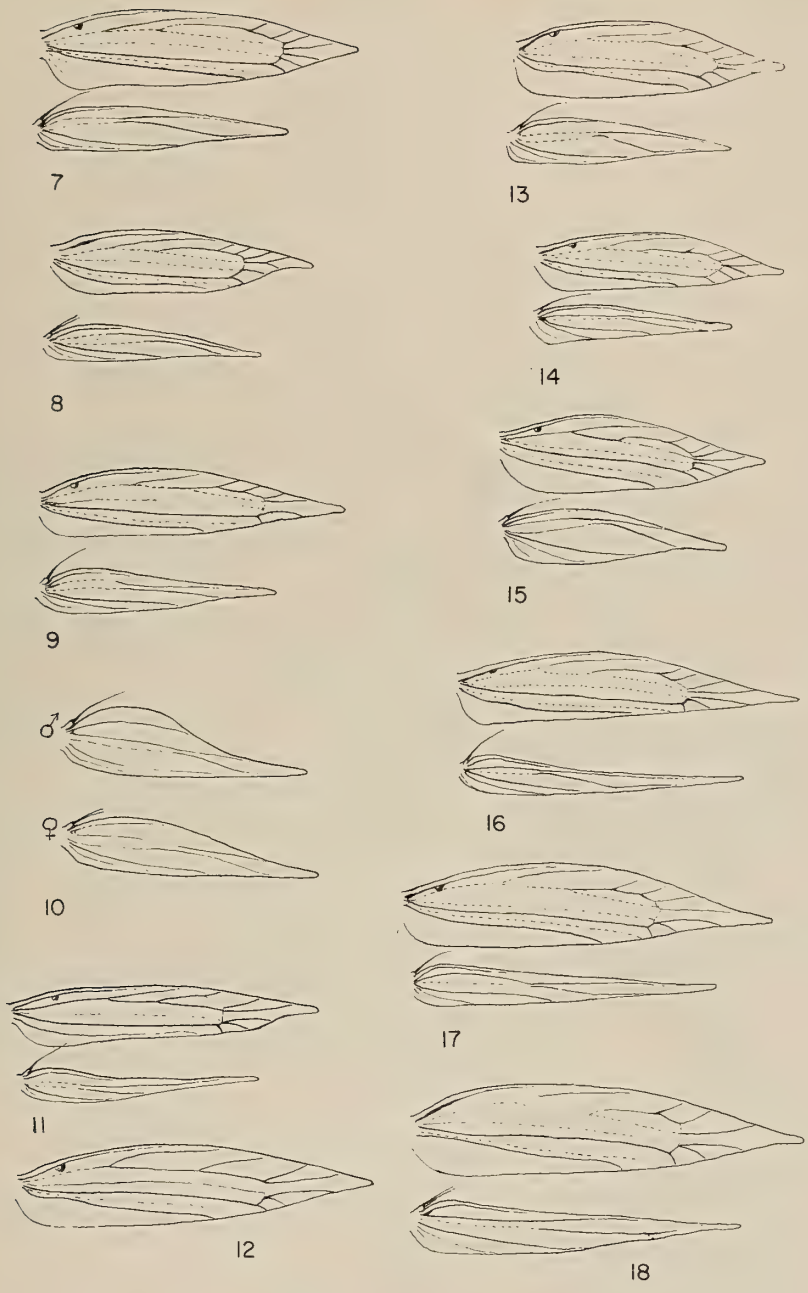
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Plate III

Larvae and Pupae

The line represents 1 mm.

Fig. 19. — *Tischeria badiiella* Chambers, dorsal view of pupa of male; 19a, lateral view to show tubercle on vertex, enlarged; 19b, lateral view of tip of abdomen, enlarged. Cincinnati, Ohio.

Fig. 20. — *Tischeria aenea* Frey and Boll, dorsal view of pupa of male. Fort Hill State Memorial, Highland County, Ohio.

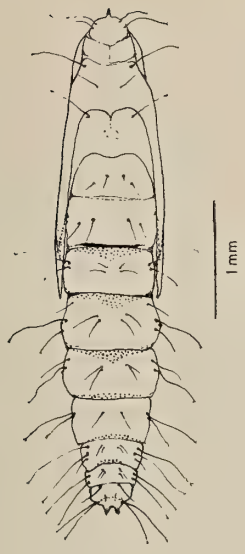
Fig. 21. — *Tischeria astericola* new species, ventral view of pupa of female. Cincinnati, Ohio.

Fig. 22. — *Tischeria heliopsisella* Chambers, ventral view of last instar larva. Clermont County, Ohio.

Fig. 23. — *Tischeria badiiella* Chambers, dorsal view of last instar larva. Mammoth Cave National Park, Kentucky.

Fig. 24. — *Tischeria zelleriella* Clemens, dorsal view of head and thoracic segments of last instar larva. Mammoth Cave National Park, Kentucky.

Fig. 25. — *Tischeria quercitella* Clemens, dorsal view of head, thorax, and first abdominal segment in diapause before pupation. Adams County, Ohio.



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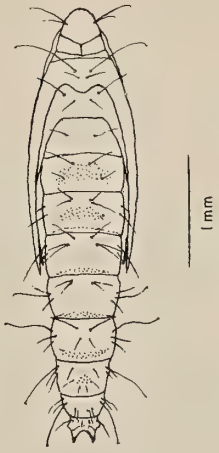
19a

19b



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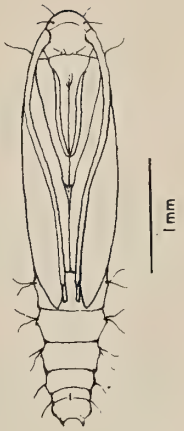

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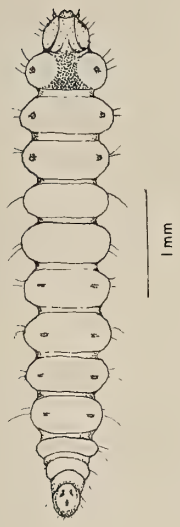

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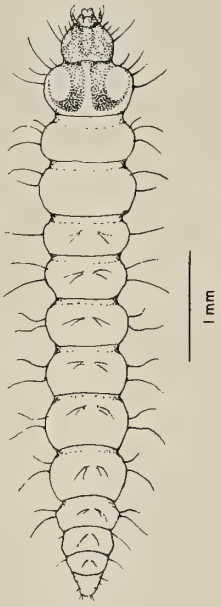

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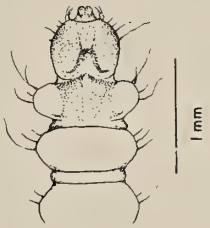

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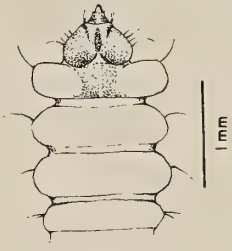

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Plate IV

Mines on Leaves of Species of *Quercus*

All figures natural size

Fig. 26. — *Tischeria citrinipennella* Clemens, completed mine on *Quercus imbricaria* Michx. Adams County, Ohio.

Fig. 27. — *Tischeria mediostriata* Braun, completed mine on *Quercus gambelii* Nutt., Canyon City, Colorado; 27a, early stage of mine, Black Canyon of the Gunnison National Monument, Colorado.

Fig. 28. — *Tischeria consanguinea* new species, mines on leaves of *Quercus dumosa* Nutt. Hemet, Riverside County, California.

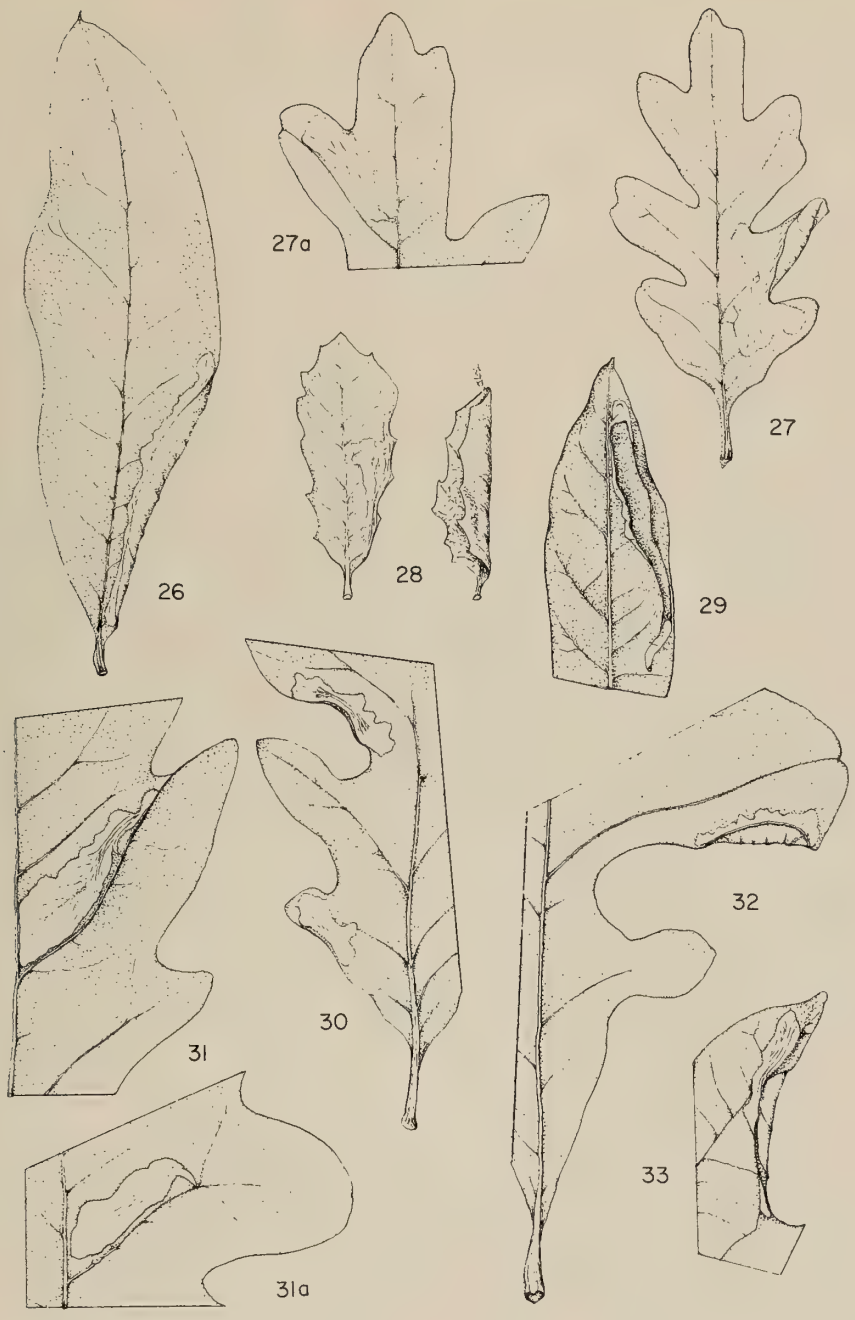
Fig. 29. — *Tischeria distincta* new species, mine on *Quercus hypoleucoides* A. Camus. Madera Canyon, Santa Rita Mountains, Arizona.

Fig. 30. — *Tischeria purinosella* Chambers, an early stage of mine, and mine at pupation, on *Quercus alba* L. Cincinnati, Ohio.

Fig. 31. — *Tischeria badiiella* Chambers, mine at time of pupation on *Quercus alba* L.; 31a, early stage of mine. Cincinnati, Ohio.

Fig. 32. — *Tischeria simulata* new species, mine on *Quercus stellata* Wangenh. Russelville, Logan County, Kentucky.

Fig. 33. — *Tischeria simulata* new species, mine on *Quercus alba* L. Rowan County, Kentucky.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27a
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31
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32
33
31a

Plate V

Mines on Leaves of Species of *Quercus*

All figures natural size

Fig. 34. — *Tischeria discreta* new species, mine on *Quercus wislizenii* A. DC. Keene, Kern County, California.

Fig. 35. — *Tischeria discreta* new species, mine on *Quercus agrifolia* Née. San Luis Obispo County, California.

Fig. 36. — *Tischeria discreta* new species, a very early stage of mine on *Quercus wislizenii* var. *frutescens* Engelm.; a glistening egg lies against the midrib. Keene, Kern County, California.

Fig. 37. — *Tischeria arizonica* new species, completed mine on *Quercus arizonica* Sarg.; 37a, an earlier stage of mine. Pine, Gila County, Arizona.

Fig. 38. — *Tischeria clemensella* Chambers, mine on *Quercus palustris* Muenchh. Cincinnati, Ohio.

Fig. 39. — *Tischeria fuscomarginella* Chambers, completed mine on *Quercus prinus* L. (*Q. montana* Willd.). McCreary County, Kentucky.

Fig. 40. — *Tischeria zelleriella* Clemens, mine at time of pupation, on *Quercus alba* L. Brown County, Ohio.

Fig. 41. — *Tischeria castaneaeella* Chambers, mine on *Quercus velutina* Lam. Fort Hill State Memorial, Highland County, Ohio.

Fig. 42. — *Tischeria quercitella* Clemens, mine on *Quercus* sp. District of Columbia.

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37a

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Plate VI

Mines of Rosaceous and Composite Feeders

All mines natural size

Fig. 43. — *Tischeria crataegifoliae* new species, mine on *Crataegus* sp. Pike Lake, Pike County, Ohio.

Fig. 44. — *Tischeria admirabilis* Braun, mine on terminal leaflet of *Rosa palustris* Marsh. Eastwood, Brown County, Ohio.

Fig. 45. — *Tischeria roseticola* Frey and Boll, mines on leaf of *Rosa setigera* Michx. Stonelick Lake, Clermont County, Ohio.

Fig. 46. — *Tischeria aenea* Frey and Boll, early and completed mines on *Rubus allegheniensis* Porter. Fort Hill State Memorial, Highland County, Ohio.

Fig. 47. — *Tischeria malifoliella* Clemens, mine on apple leaf. Cincinnati, Ohio.

Fig. 48. — *Tischeria heliopsisella* Chambers, mine on *Heliopsis helianthoides* (L.) Sweet, aspect on upper side of leaf; 48a, early stage of mine. Stonelick Lake, Clermont County, Ohio.

Fig. 49. — *Tischeria ambrosiaeella* Chambers, mine on *Ambrosia trifida* L., aspect on upper side of leaf. Stonelick Lake, Clermont County, Ohio.

Fig. 50. — *Tischeria solidaginifoliella* Clemens, mine on *Solidago altissima* L., aspect on upper side of leaf; 50a, aspect of mine on the lower side of leaf. Fort Hill State Memorial, Highland County, Ohio.


43
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48a
49
50a
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Plate VII

Mines on Leaves of Compositae and *Ceanothus*

Figs. 51 to 53, natural size; Figs. 54 to 57, twice natural size

Fig. 51. — *Tischeria helianthi* Frey and Boll, completed mine on *Helianthus hirsutus* Raf., aspect on upper side of leaf; 51a, aspect on lower side of leaf. Roosevelt Lake, Scioto County, Ohio.

Fig. 52. — *Tischeria gregaria* new species, completed mine on *Helianthella quinquenervis* (Hook.) Gray, aspect on lower side of leaf; 52a, aspect of mine on upper side of leaf. Grand Teton National Park, Wyoming.

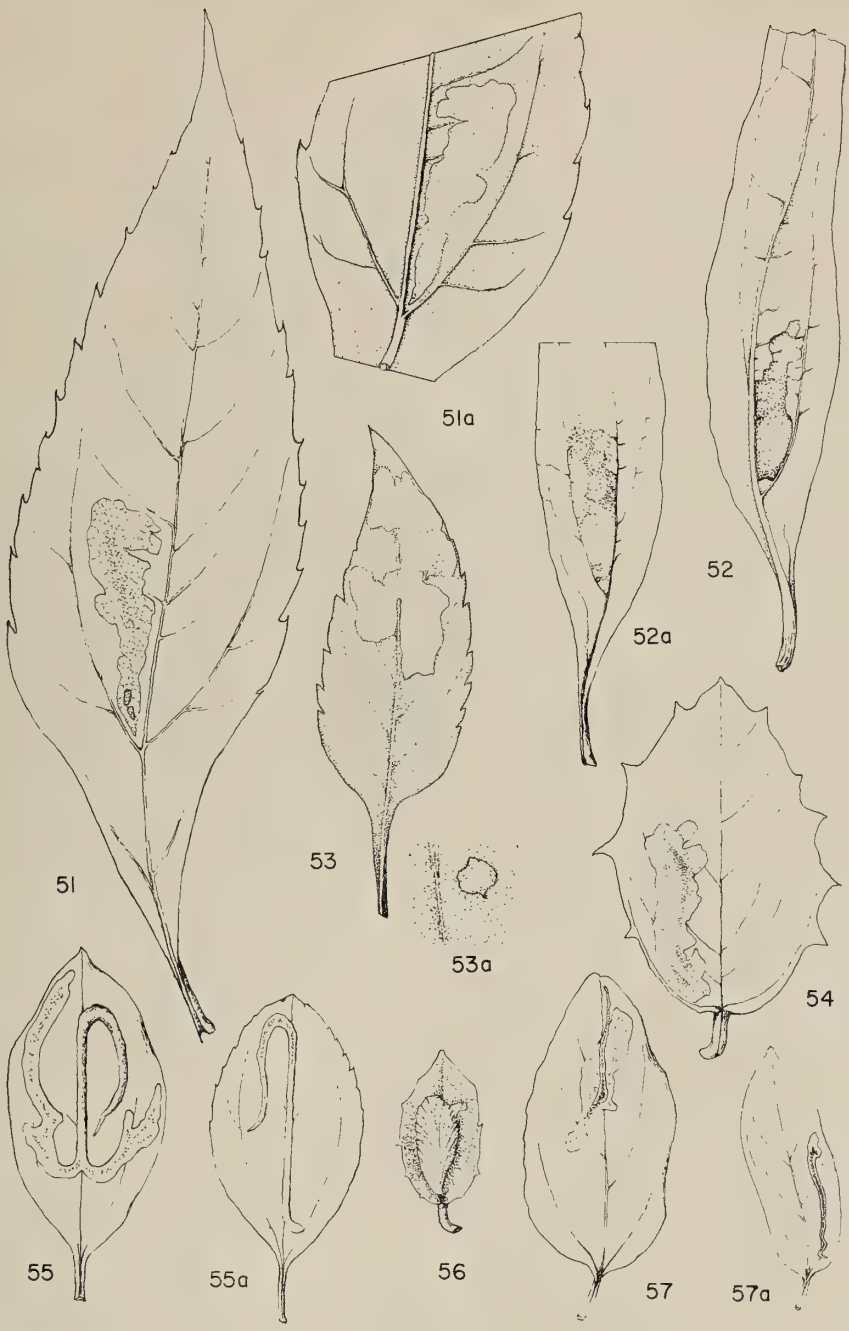
Fig. 53. — *Tischeria astericola* new species, completed mine on upper side of an upper leaf of *Aster cordifolius* L., 53a, a very early stage of mine. Cincinnati, Ohio.

Fig. 54. — *Tischeria immaculata* Braun, mine on *Ceanothus crassifolius* Torr. Loma Linda, San Bernardino County, California.

Fig. 55. — *Tischeria bifurcata* Braun, completed mine on *Ceanothus* sp.; 55a, an earlier stage of mine. Fredalba, San Bernardino County, California.

Fig. 56. — *Tischeria ambigua* Braun, completed mine on *Ceanothus oliganthus* Nutt. Fredalba, San Bernardino County, California.

Fig. 57. — *Tischeria ceanothi* Walsingham, completed mine on *Ceanothus divaricatus* Nutt.; 57a, an earlier stage of mine. Dutch Flat, Placer County, California.


51
51a
52
52a
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53a
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55
55a
56
57
57a

Plate VIII
Male Genitalia: Section I

Fig. 58. — *Tischeria citrinipennella* Clemens, ventral view, (left harpe, anellus, and aedeagus omitted); 58a, aedeagus and anellus. Cincinnati, Ohio.

Fig. 59. — *Tischeria mediostriata* Braun, ventral view (left harpe and aedeagus omitted); 59a, aedeagus. Oak Creek Canyon, Arizona.

Fig. 60. — *Tischeria consanguinea* new species, paratype, ventral view (left harpe and aedeagus omitted); 60a, aedeagus. Guatay, San Diego County, California.

Fig. 61. — *Tischeria badiiella* Chambers, ventral view (anellus and aedeagus omitted); 61a, aedeagus; 61b, anellus. Winnfield, Louisiana.

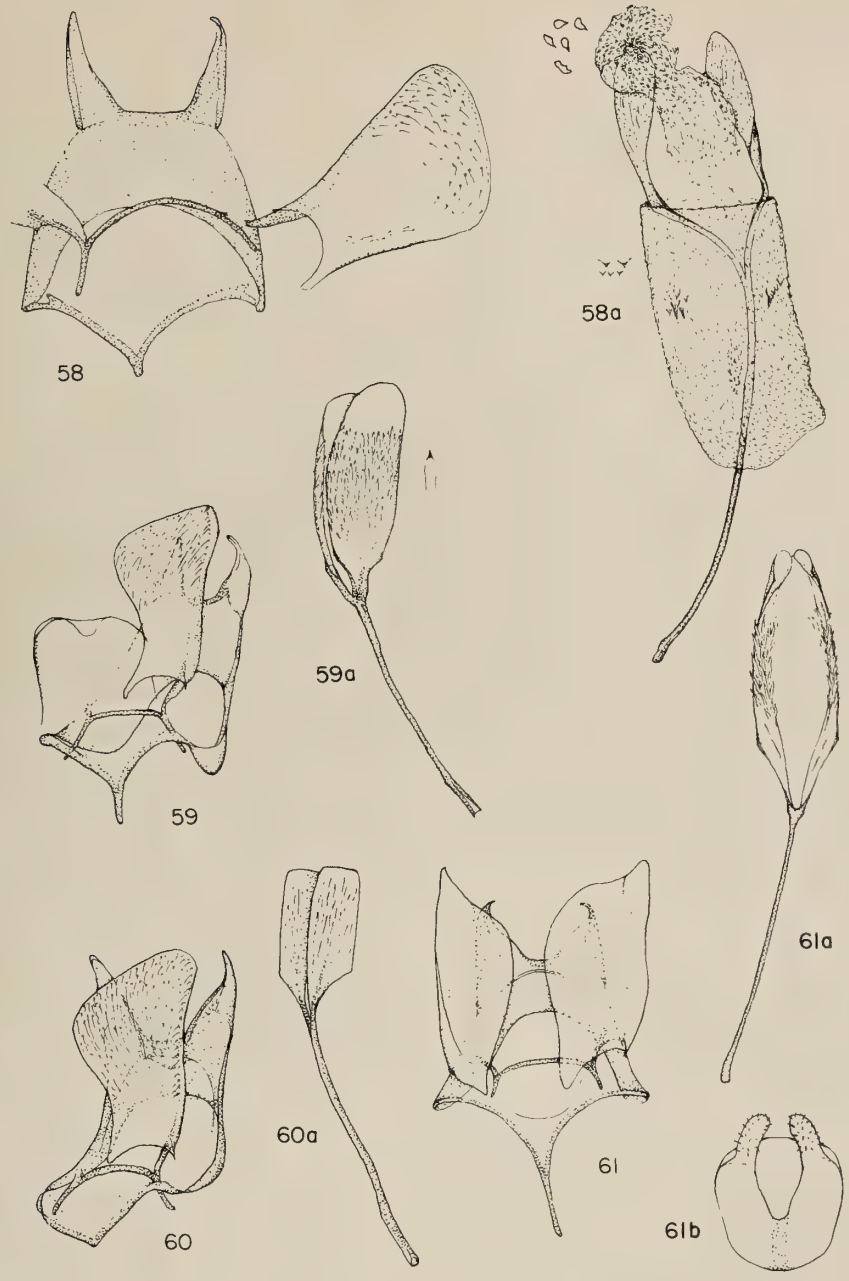

58
58a
59
59a
60
60a
61
61a
61b

Plate IX

Male Genitalia: Section I

Fig. 62. — *Tischeria lucida* new species, paratype, ventral view (left harpe and aedeagus omitted); 62a, aedeagus, lateral view. Parker Is, Highland County, Florida.

Fig. 63. — *Tischeria distincta* new species, paratype, ventral view (right harpe and aedeagus omitted); 63a, aedeagus. Madera Canyon, Santa Rita Mountains, Arizona.

Fig. 64. — *Tischeria subnubila* new species, type, ventral view (left harpe and aedeagus omitted); 64a, aedeagus. Carlsbad National Park, New Mexico.

Fig. 65. — *Tischeria simulata* new species, type, ventral view (left harpe and aedeagus omitted); 65a, aedeagus. Morehead, Rowan County, Kentucky.

Fig. 66. — *Tischeria concolor* Zeller, ventral view (left harpe and aedeagus omitted); 64a, aedeagus. Washington, D. C.

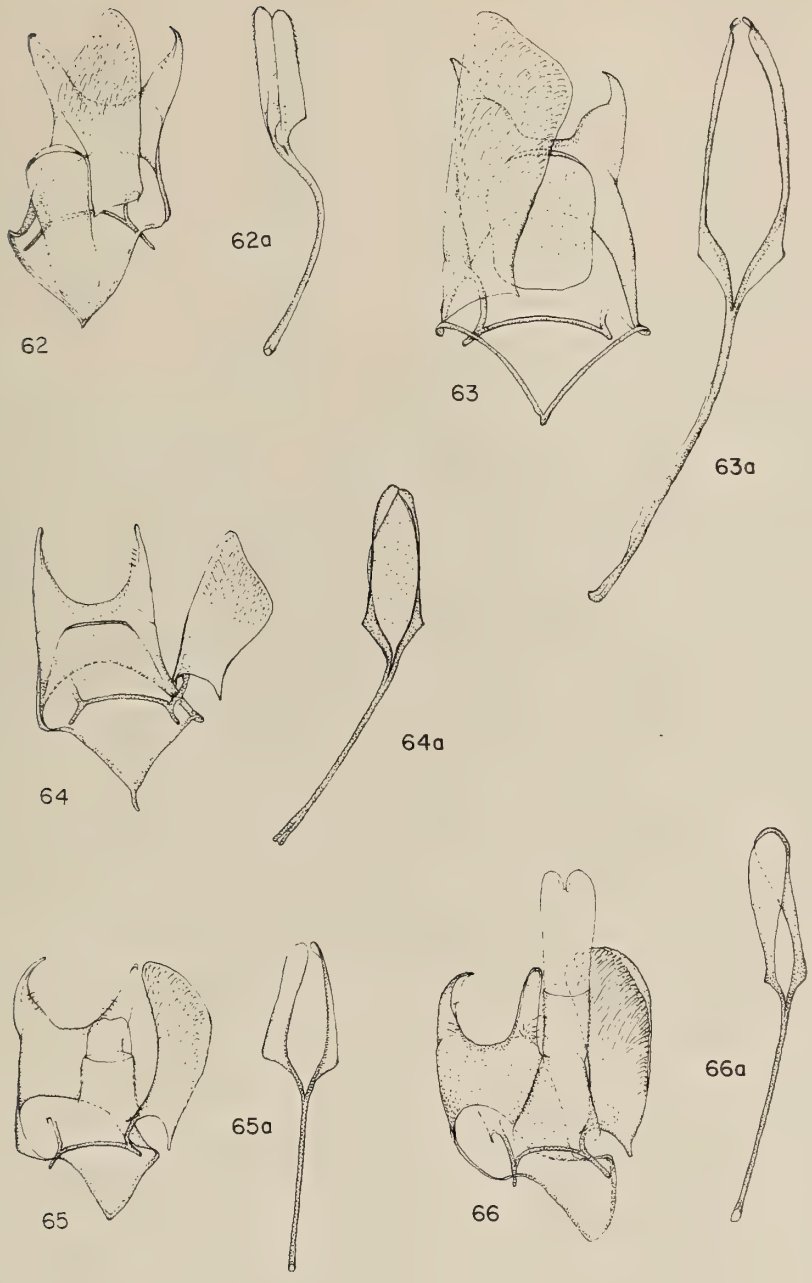

62
62a
63
63a
64
64a
65
65a
66
66a

Plate X

Male Genitalia: Section I

Fig. 67. — *Tischeria purinosella* Chambers, ventral view (right harpe and aedeagus omitted); 67a, aedeagus. Cincinnati, Ohio.

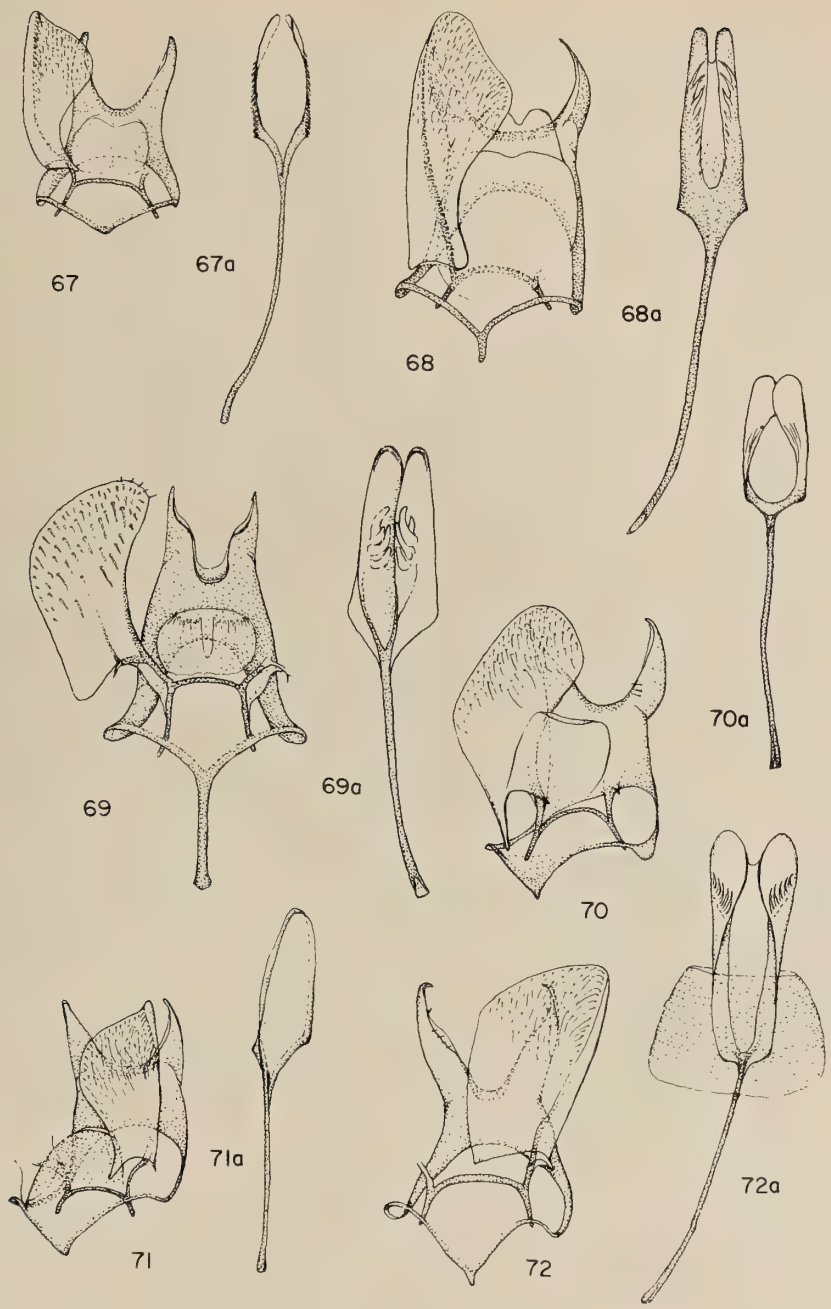
Fig. 68. — *Tischeria discreta* new species, paratype, ventral view (right harpe and aedeagus omitted); 68a, aedeagus. Keene, Kern County, California.

Fig. 69. — *Tischeria arizonica* new species, paratype, ventral view (right harpe and aedeagus omitted); 69a, aedeagus. Pine, Gila County, Arizona.

Fig. 70. — *Tischeria clemensella* Chambers, ventral view (right harpe and aedeagus omitted); 70a, aedeagus. Cincinnati, Ohio.

Fig. 71. — *Tischeria fuscomarginella* Chambers, ventral view (left harpe and aedeagus omitted); 71a, aedeagus. Carter Caves State Park, Carter County, Kentucky.

Fig. 72. — *Tischeria castaneaeella* Chambers, ventral view (left harpe, aedeagus, and anellus omitted); 72a, aedeagus and anellus. Morehead, Rowan County, Kentucky.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67a
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69a
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70a
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71a
72
72a

Plate XI

Male Genitalia: Section I

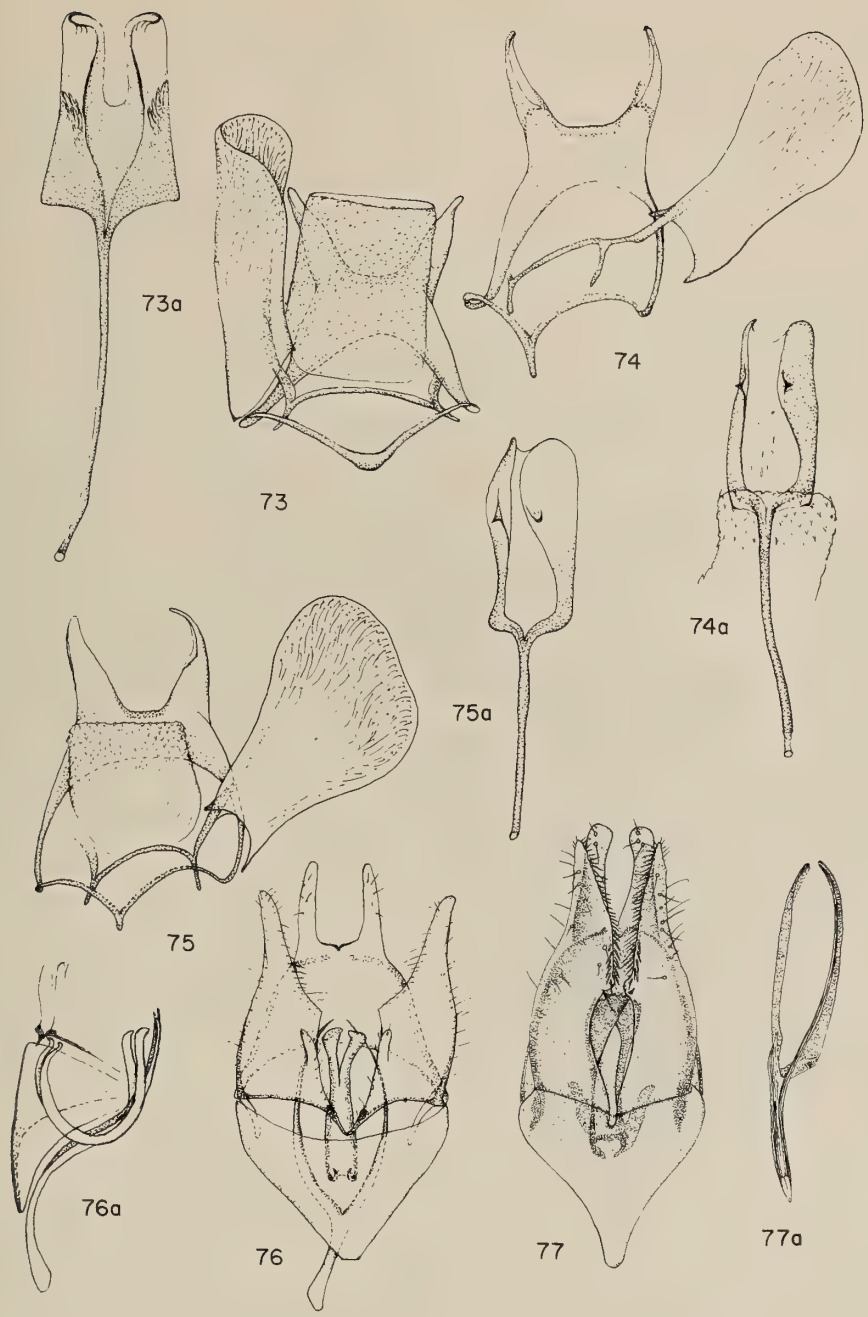
Fig. 73. — *Tischeria perplexa* new species, type, ventral view (right harpe and aedeagus omitted); 73a, aedeagus. Falls Church, Virginia.

Fig. 74. — *Tischeria zelleriella* Clemens, ventral view (left harpe, anellus, and aedeagus omitted); 74a, anellus and aedeagus. Cincinnati, Ohio.

Fig. 75. — *Tischeria sulphurea* Frey and Boll, ventral view (left harpe and aedeagus omitted); 75a, aedeagus. District of Columbia.

Fig. 76. — *Tischeria quercitella* Clemens, ventral view. Lewis County, Kentucky. Fig. 76a, lateral view to show relation of anellus to harpe and aedeagus. Slide 3087, J.F.G.C. Putnam County, Illinois.

Fig. 77. — *Tischeria elongata* Walsingham, type, ventral view (aedeagus omitted); 77a, aedeagus. BM slide 15283. Amula, Guerrero, Mexico.


73a
73
74
74a
75a
75
76a
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77a

Plate XII

Male Genitalia: Section II

All figures twice the magnification of figures of Section I

Fig. 78. — *Tischeria malifoliella* Clemens, semi-lateral view (aedeagus omitted); 78a, aedeagus. Clermont County, Ohio.

Fig. 79. — *Tischeria crataegifoliae* new species, paratype, ventral view (aedeagus omitted); 79a, aedeagus. Cincinnati, Ohio.

Fig. 80. — *Tischeria roseticola* Frey and Boll, semi-lateral view (aedeagus omitted); 80a, aedeagus. Clermont County, Ohio.

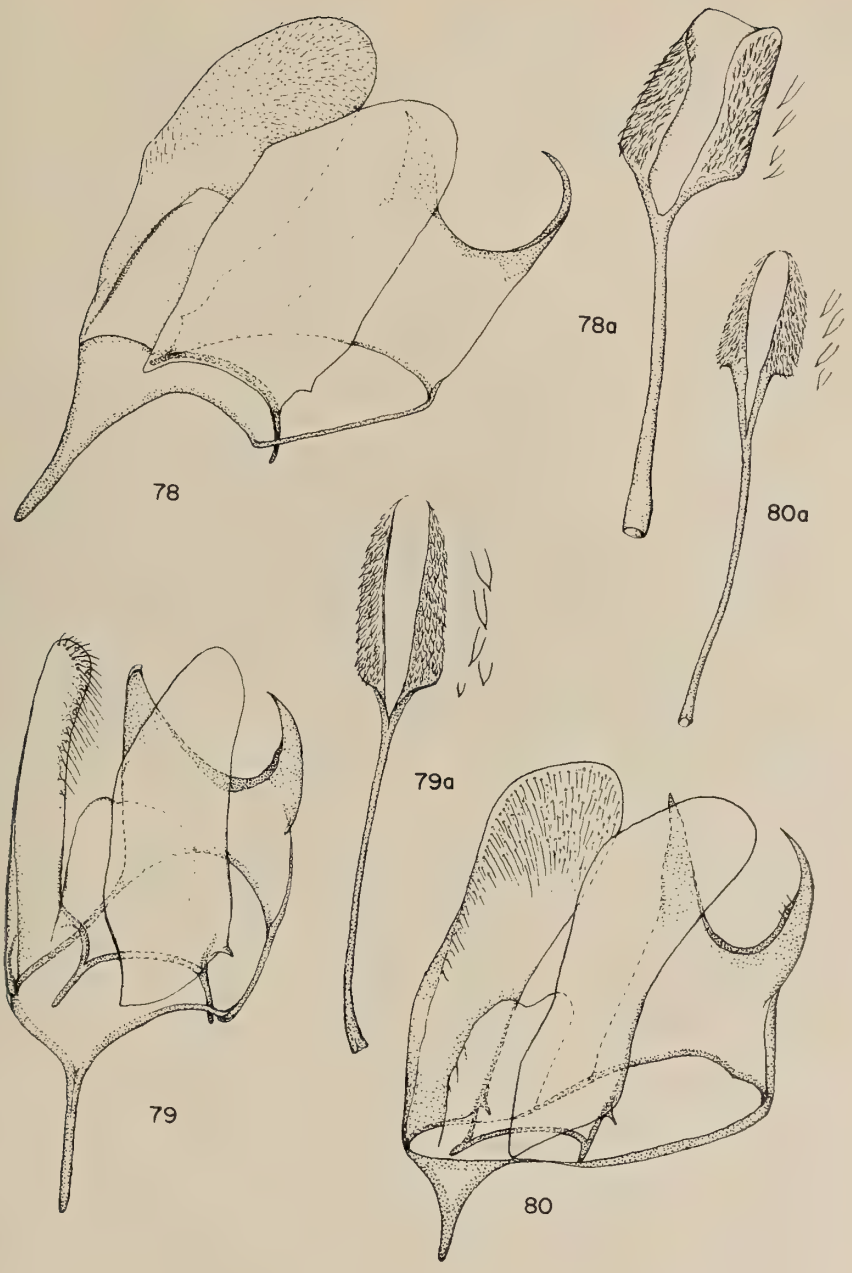

78
78a
80a
79a
79
80

Plate XIII

Male Genitalia: Section II

All figures twice the magnification of figures of Section I

Fig. 81. — *Tischeria agrimoniella* new species, paratype, semi-lateral view (aedeagus omitted); 81a, aedeagus. Cincinnati, Ohio.

Fig. 82. — *Tischeria aenea* Frey and Boll, semi-lateral view (aedeagus omitted); 82a, aedeagus. Cincinnati, Ohio.

Fig. 83. — *Tischeria splendida* new species, type, semi-lateral view (aedeagus omitted); 83a, aedeagus. Russelmann Park, Contra Costa County, California.

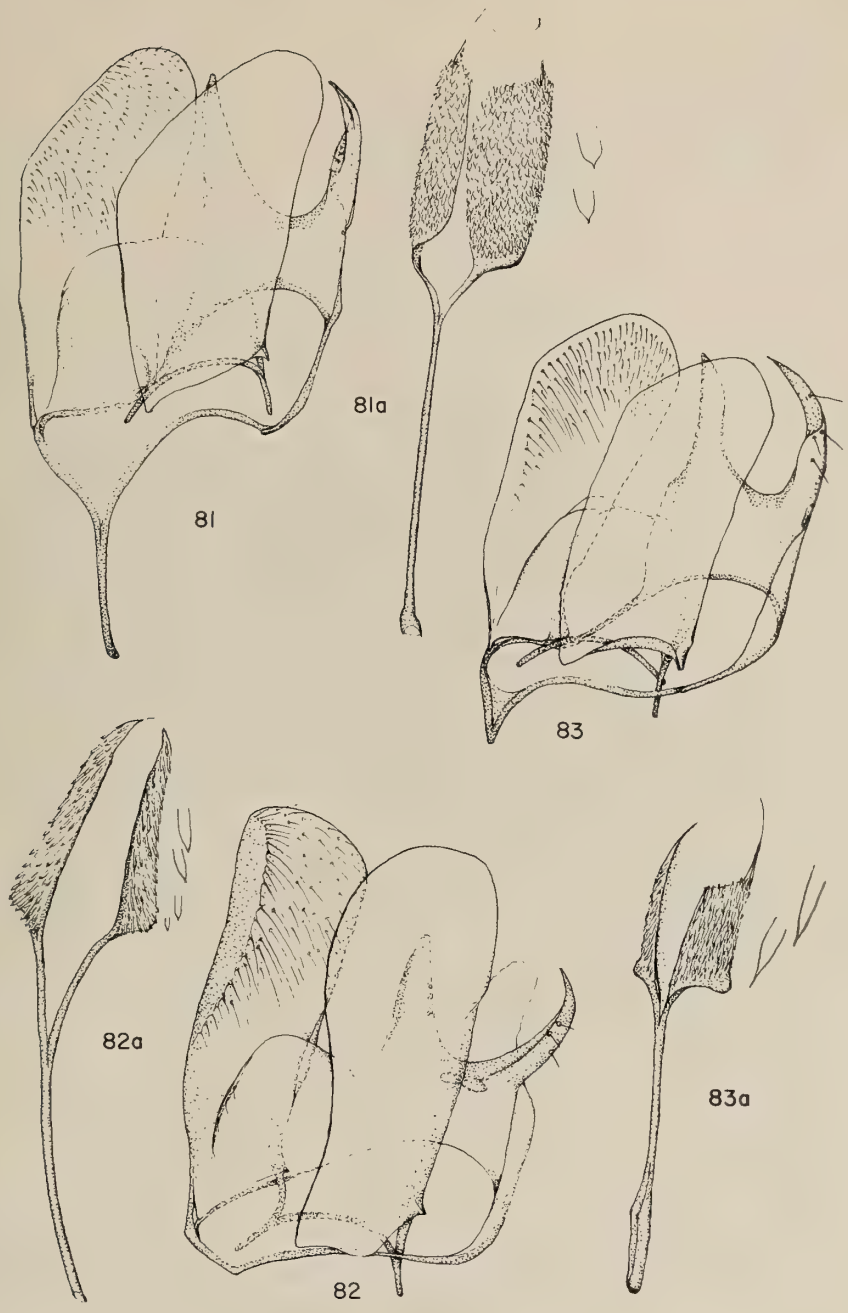

81a
81
83
82a
82
83a

Plate XIV

Male Genitalia: Section II

All figures twice the magnification of figures of Section I

Fig. 84. — *Tischeria insolita* new species, type, ventral view (aedeagus omitted); 84a, aedeagus. New Lisbon, New Jersey.

Fig. 85. — *Tischeria confusa* new species, type, ventral view (left harpe and aedeagus omitted); 85a, aedeagus, Slide 9926, J.F.G.C.; 85b, semi-lateral view of vinculum, tegumen, and uncus. Sacramento, California.

Fig. 86. — *Tischeria amelanchieris* new species, paratype, ventral view (aedeagus omitted); 86a, aedeagus. Mineral Springs, Adams County, Ohio.

Fig. 87. — *Tischeria inexpectata* new species, type, ventral view (aedeagus omitted); 87a, aedeagus. Sacramento, California.

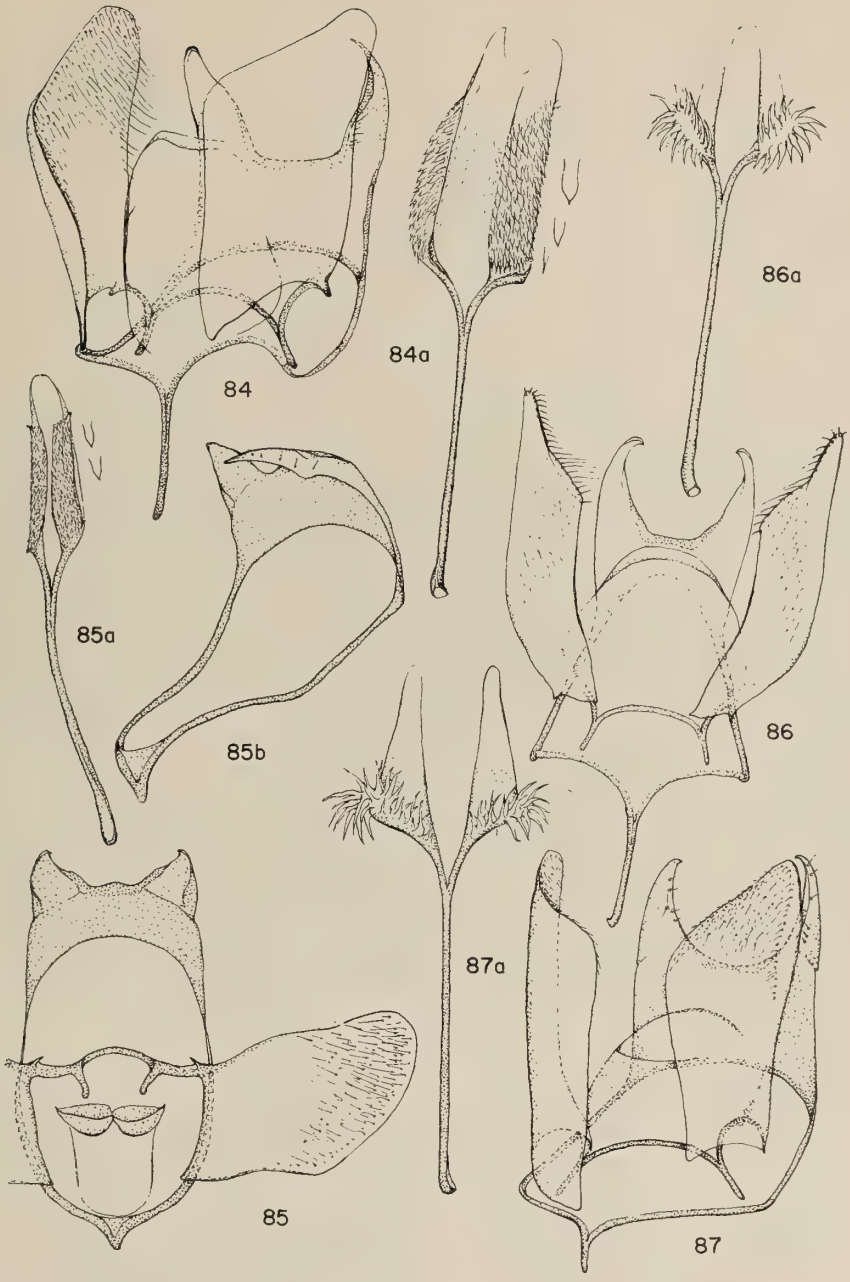

84
84a
86a
85a
85b
86
87a
85
87

Plate XV

Male Genitalia: Sections II and III

Figure 88 (Section II) twice the magnification of figures of Section III

Fig. 88. — *Tischeria admirabilis* Braun, ventral view (aedeagus omitted); 88a, aedeagus. Beaver Pond, Adams County, Ohio.

Fig. 89. — *Tischeria solidaginifoliella* Clemens, lateral view (aedeagus omitted); 89a, aedeagus. Cincinnati, Ohio.

Fig. 90. — *Tischeria astericola* new species, paratype, ventral view (aedeagus omitted); 90a, aedeagus. Cincinnati, Ohio. Fig. 90b, a different aspect of anellus. Balsam, North Carolina.

Fig. 91. — *Tischeria occidentalis* new species, paratype, ventral view (aedeagus omitted); 91a, aedeagus. Grand Teton National Park, Wyoming.

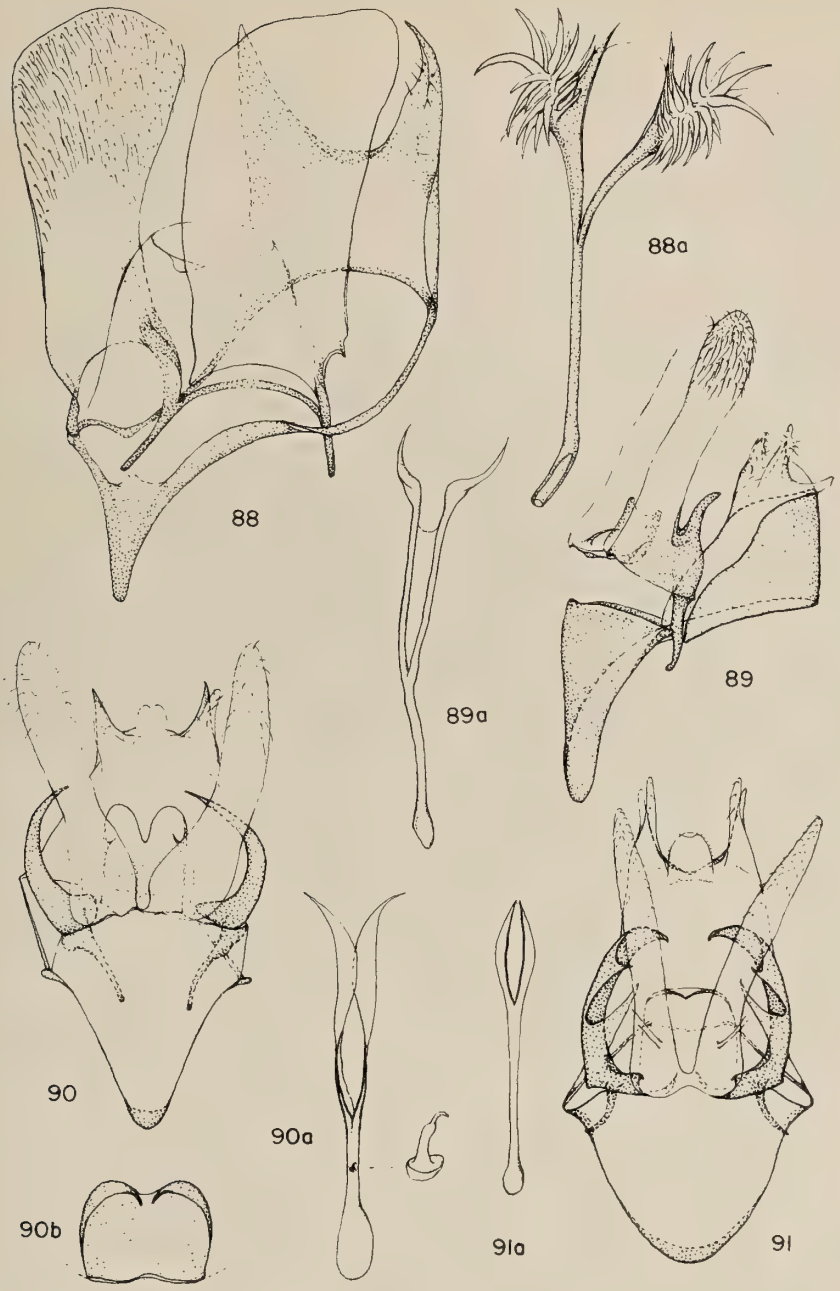

88
88a
89
89a
90
90a
90b
91
91a

Plate XVI

Male Genitalia: Section III

Fig. 92. — *Tischeria heliopsisella* Chambers, ventral view (aedeagus omitted); 92a, aedeagus. Cincinnati, Ohio

Fig. 93. — *Tischeria ambrosiaeella* Chambers, ventral view (aedeagus omitted); 93a, aedeagus. Cincinnati, Ohio.

Fig. 94. — *Tischeria helianthi* Frey and Boll, semi-lateral view (aedeagus omitted); 94a, aedeagus. Kenton County, Kentucky.

Fig. 95. — *Tischeria gregaria* new species, paratype, ventral view (right harpe and aedeagus omitted); 95a, aedeagus. Grand Teton National Park, Wyoming.

Fig. 96. — *Tischeria marginata* new species, type, ventral view (aedeagus omitted); 96a, aedeagus. West Fork, Coconino County, Arizona.

Fig. 97. — *Tischeria pallidipennella* new species, type, ventral view (aedeagus omitted); 97a, aedeagus. Madera Canyon, Santa Rita Mountains, Arizona.

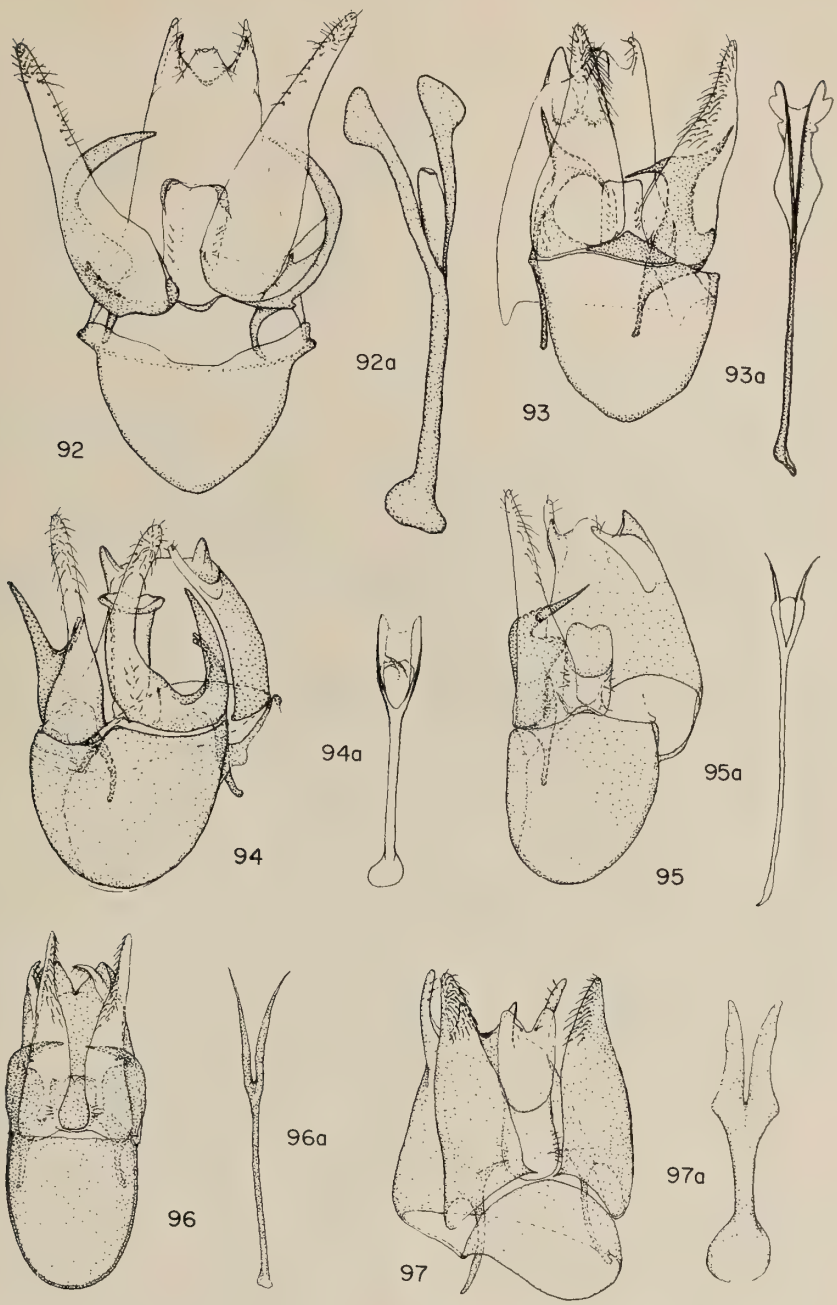

92
92a
93
93a
94
94a
95
95a
96
96a
97
97a

Plate XVII

Male Genitalia: Section IV

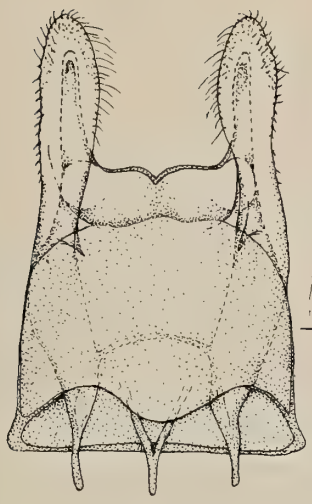
All figures twice the magnification of figures of Sections I and III

Fig. 98. — *Tischeria ceanothi* Walsingham, ventral view (anellus and aedeagus omitted); 98a, anellus and aedeagus. Dutch Flat, Placer County, California.

Fig. 99. — *Tischeria immaculata* Braun, paratype, ventral view (anellus and aedeagus omitted). Loma Linda, San Bernardino County, California.

Fig. 100. — *Tischeria ambigua* Braun, paratype, ventral view (anellus and aedeagus omitted). Fredalba, San Bernardino County, California.

Fig. 101. — *Tischeria bifurcata* Braun, ventral view. South Fork Cave Creek, Chiricahua Mountains, Arizona.



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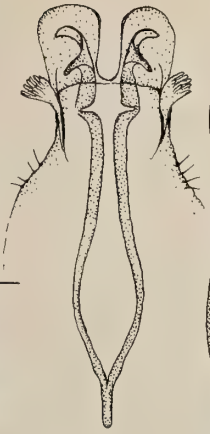

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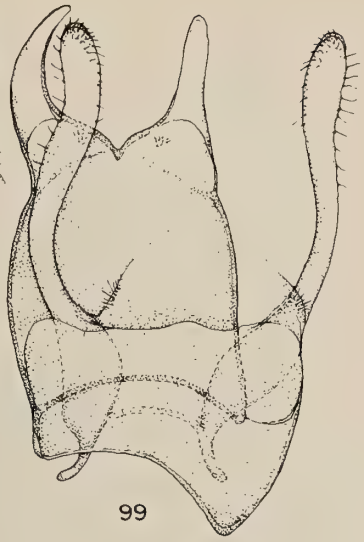

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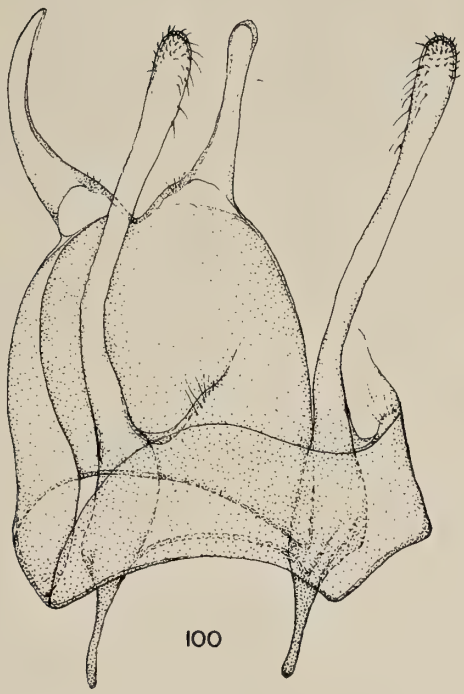

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Plate XVIII

Male and Female Genitalia: Section V

Figures 102, 104, and 105 twice the magnification of figures of Sections I and III

Fig. 102. — *Tischeria omissa* Braun, paratype, male genitalia, semi-lateral view (a portion of right harpe omitted). Berkeley, California.

Fig. 103. — *Tischeria omissa* Braun, paratype, female genitalia, lateral view (ductus bursae and bursa copulatrix omitted). Berkeley, California.

Fig. 104. — *Tischeria explosa* Braun, paratype, male genitalia, ventral view (right harpe omitted). Palm Springs, California.

Fig. 105. — *Tischeria explosa* Braun, paratype, female genitalia, ventral view (ductus bursae and bursa copulatrix omitted). Palm Springs, California.

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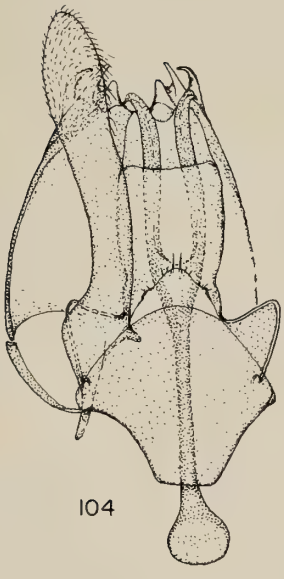

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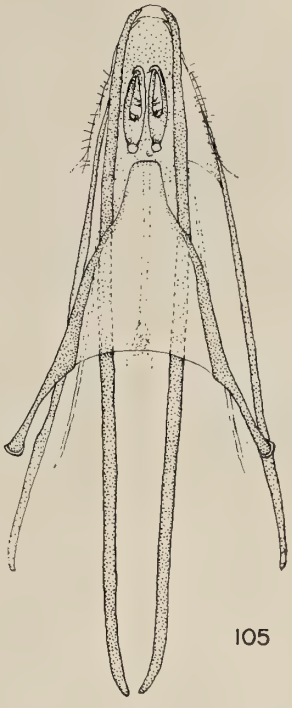

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Plate XIX

Female Genitalia: Section I

Ductus bursae and bursa copulatrix omitted

Fig. 106. — *Tischeria citrinipennella* Clemens, ventral view. Brown County, Ohio.

Fig. 107. — *Tischeria mediostriata* Braun, ventral view. Oak Creek Canyon, Arizona.

Fig. 108. — *Tischeria consanguinea* new species, paratype, ventral view. Guatay, San Diego County, California.

Fig. 109. — *Tischeria badiiella* Chambers, ventral view. Winnfield, Louisiana.

Fig. 110. — *Tischeria lucida* new species, allotype, ventral view. Oneca, Manatee County, Florida.

Fig. 111. — *Tischeria distincta* new species, paratype, ventral view. Madera Canyon, Santa Rita Mountains, Arizona.

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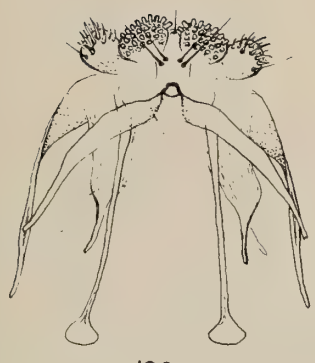
Fig. 113. — *Tischeria concolor* Zeller, ventral view. Devil's Den State Park, Washington County, Arkansas.

Fig. 114. — *Tischeria simulata* new species, paratype, ventral view. Devil's Den State Park, Washington County, Arkansas.



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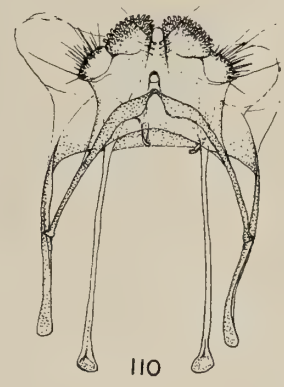

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Plate XX

Female Genitalia: Section I

Fig. 115. — *Tischeria purinosella* Chambers, ventral view (ductus bursae and bursa copulatrix omitted). Cincinnati, Ohio.

Fig. 116. — *Tischeria discreta* new species, paratype, ventral view (ductus bursae and bursa copulatrix omitted). Keene, Kern County, California.

Fig. 117. — *Tischeria arizonica* new species, paratype, ventral view (bursa copulatrix omitted). Pine, Gila County, Arizona.

Fig. 118. — *Tischeria clemensella* Chambers, ventral view (ductus bursae and bursa copulatrix omitted). Cincinnati, Ohio.

Fig. 119. — *Tischeria castaneaeella* Chambers, ventral view (ductus bursae and bursa copulatrix omitted). Beaver Pond, Adams County, Ohio.

Fig. 120. — *Tischeria fuscomarginella* Chambers, ventral view. Natural Arch, McCreary County, Kentucky.

Fig. 121. — *Tischeria quercitella* Clemens, ventral view (bursa copulatrix omitted). Cincinnati, Ohio.

Fig. 122. — *Tischeria perplexa* new species, allotype, ventral view (ductus bursae and bursa copulatrix omitted). Falls Church, Virginia.

Fig. 123. — *Tischeria zelleriella* Clemens, ventral view (ductus bursae and bursa copulatrix omitted). Cincinnati, Ohio.

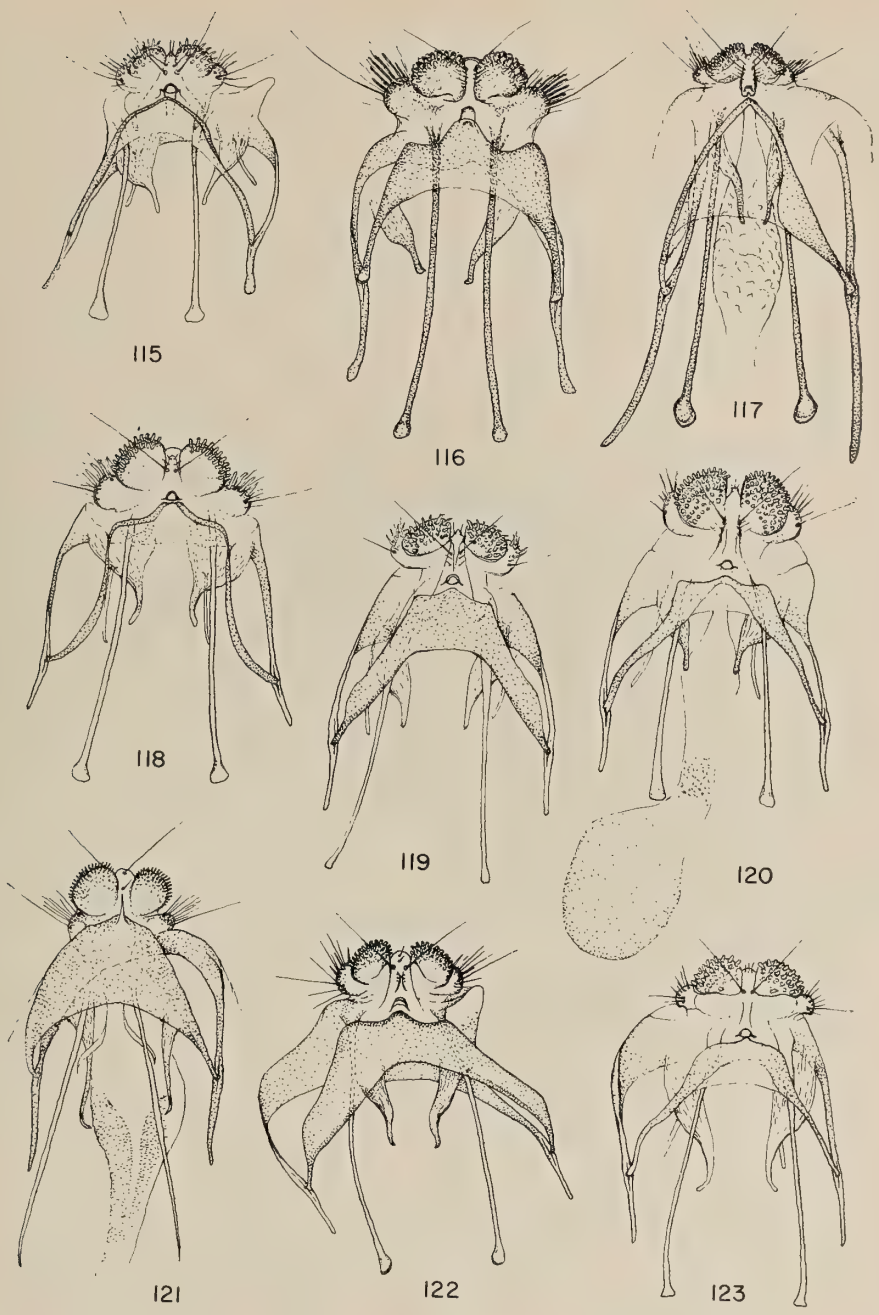
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Plate XXI

Female Genitalia: Section II

Ductus bursae and bursa copulatrix omitted

All figures twice the magnification of figures of Section I

Fig. 124. — *Tischeria malifoliella* Clemens, ventral view. Cincinnati, Ohio.

Fig. 125. — *Tischeria crataegifoliae* new species, paratype, ventral view. Ottawa, Ontario.

Fig. 126. — *Tischeria roseticola* Frey and Boll, ventral view. Clermont County, Ohio.

Fig. 127. — *Tischeria agrimoniella* new species, paratype, ventral view. Cincinnati, Ohio.

Fig. 128. — *Tischeria aenea* Frey and Boll, ventral view. Mineral Springs, Adams County, Ohio.

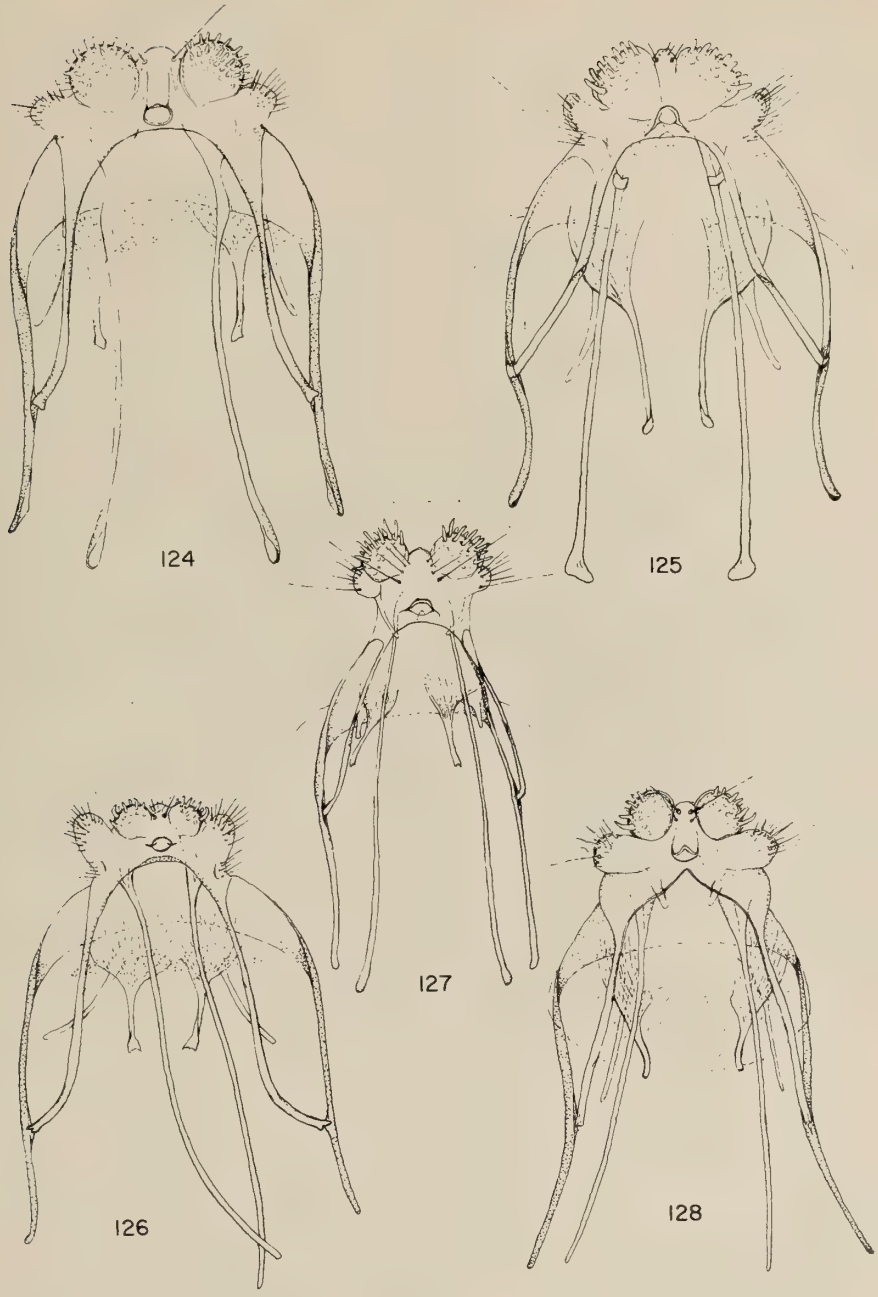
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Plate XXII

Female Genitalia: Section II

Ductus bursae and bursa copulatrix omitted

All figures twice the magnification of figures of Section I

Fig. 129. — *Tischeria splendida* new species, paratype, ventral view. Russelmann Park, Contra Costa County, California.

Fig. 130. — *Tischeria insolita* new species, allotype, ventral view. New Lisbon, New Jersey.

Fig. 131. — *Tischeria confusa* new species, allotype, ventral view. Sacramento, California.

Fig. 132. — *Tischeria inexpectata* new species, allotype, ventral view. Sacramento, California.

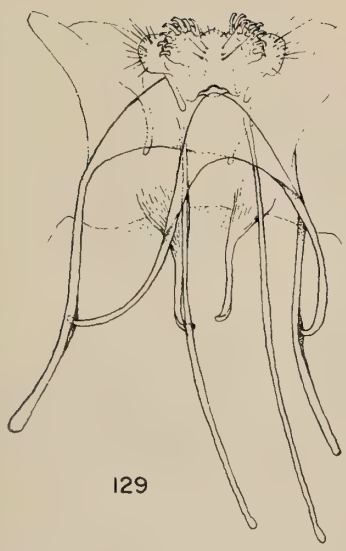

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Plate XXIII

Female Genitalia: Sections II and III

Figures 133 and 134 twice the magnification of figures of Section III

Fig. 133. — *Tischeria amelanchieris* new species, paratype, ventral view (ductus bursae and bursa copulatrix omitted). Mineral Springs, Adams County, Ohio.

Fig. 134. — *Tischeria admirabilis* Braun, ventral view (ductus bursae and bursa copulatrix omitted). Cedar Falls, Adams County, Ohio.

Fig. 135. — *Tischeria solidaginifoliella* Clemens, ventral view (ductus bursae and bursa copulatrix omitted). Cincinnati, Ohio.

Fig. 136. — *Tischeria astericola* new species, paratype, ventral view (bursa copulatrix omitted). Cincinnati, Ohio.

Fig. 137. — *Tischeria occidentalis* new species, allotype, ventral view (bursa copulatrix omitted). Grand Teton National Park, Wyoming.

Fig. 138. — *Tischeria heliopsisella* Chambers, ventral view (bursa copulatrix omitted). Cincinnati, Ohio.

Fig. 139. — *Tischeria ambrosiaeella* Chambers, ventral view (ductus bursae and bursa copulatrix omitted); a, plate of posterior dorsal margin of segment 7. Cincinnati, Ohio.

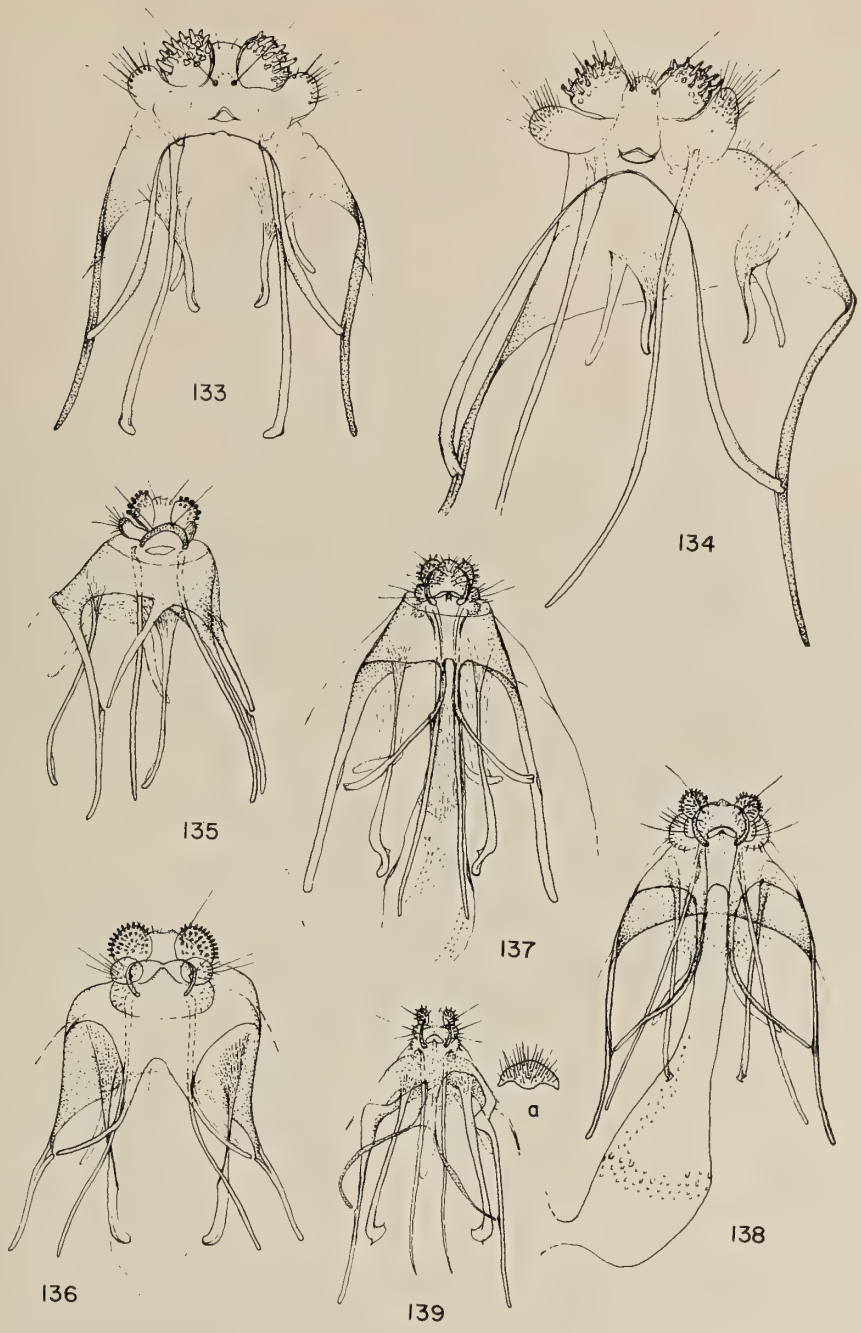
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Plate XXIV

Female Genitalia: Sections III and IV

Fig. 140. — *Tischeria helianthi* Frey and Boll, ventral view (ductus bursae and bursa copulatrix omitted). Kenton County, Kentucky.

Fig. 141. — *Tischeria gregaria* new species, paratype, ventral view (bursa copulatrix omitted). Grand Teton National Park, Wyoming.

Fig. 142. — *Tischeria marginata* new species, allotype, ventral view (bursa copulatrix omitted). South Fork Cave Creek, Chiricahua Mountains, Arizona.

Fig. 143. — *Tischeria heteroterae* Frey and Boll, type, ventral view; BM slide 15284. Dallas, Texas.

Fig. 144. — *Tischeria ceanothi* Walsingham, ventral view (bursa copulatrix omitted). Dutch Flat, Placer County, California.

Fig. 145. — *Tischeria immaculata* Braun, paratype, ventral view (bursa copulatrix omitted). Loma Linda, San Bernardino County, California.

Fig. 146. — *Tischeria bifurcata* Braun, ventral view (ductus bursae and bursa copulatrix omitted). South Fork Cave Creek, Chiricahua Mountains, Arizona.

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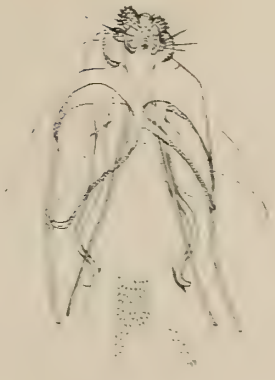

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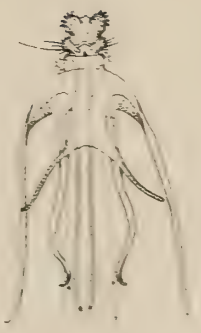

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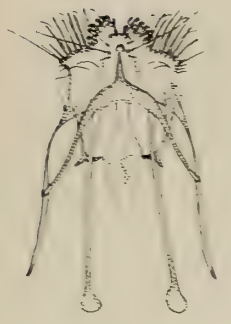

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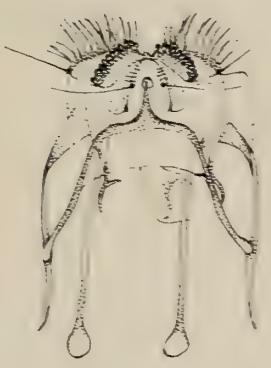

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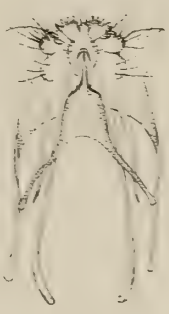

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